Electrical World

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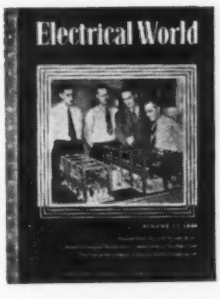

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Electrical World

AUGUST 17, 1946

Over-All Generation Economy

It is a safe guess that there are too many managements so preoccupied with other matters that they do not take intimate interest in the basic patterns of their future generating stations. Conversely, it is possible that not all of the engineers who design these plants are giving full consideration to prevailing economic factors, and particularly the changes which have and will take place in them. The plant most economical over its whole life will not result unless this gap is bridged wherever it exists. Generation cost is not now a generally dominant factor in the rate to the customer but it may prove to be more so if consumptions are built up to talked-of levels. This is particularly a possibility if much larger demands and outputs can be handled without proportionate increases in the cost of the distribution system, at present the largest factor.

Right now money is cheap but fuel, materials and labor are more expensive than ever before. Manpower to operate the plants has been reduced to a safe minimum in many recent plants and it is not difficult to continue achieving that objective in the plants ahead. The crux from the labor angle is in maintenance and it appears that more effort could be applied in that direction. Production for war very often demanded the utmost in reliability, albeit sometimes for equipment permissibly short-lived. Anyhow progress in general in building steam-end equipment has resulted in more nearly equalizing with the generating equipment the number of hours that boilers and associated facilities will run without upkeep attention by the station staff. Automatic soot blowing and kindred functions help keep the equipments working without interruptions for upkeep. How much can be spent for such aids and still keep the annual costs down?

Convenient arrangement of the controls and instruments should be an objective not only to help the operator perform his routine functions efficiently and happily but also to give him assurance that he will, by having everything possible within a step's reach, be confident that he can be calm and competent when emergencies arise.

These are aspects where managements should intrude to fix the over-all economic objectives as well as lay down for the design engineers the amount of investment outlay geared to getting the lowest busbar cost, year in and year out, for the kilowatt-hours ground out. Another is the possibility, with ash content increasing, to reach out deliberately for poorer grades of coal and design the plant to utilize them smoothly and efficiently. That is just one added way that mounting fuel cost can perhaps be countered.

In short, today's circumstances call more than ever for executive analysis, to decide how long they are likely to last and what relative weights should be attached to each factor for the present and the future. It's a matter of money, men, material, maintenance, markets for power, logical margins of capacity. If managements canvass those components, there will be fewer misfits and fewer stations that reflect the suspicion of being monuments to materialistic engineering.

ONE THOUSAND F...

A New High in Steam Temperature

PHILIP SPORN, *Executive Vice-President and Chief Engineer, American Gas & Electric Service Corp., N. Y.*

Missouri Avenue Plant of Atlantic City Electric installing 30-mw. unit to operate with throttle steam at 1,350 psi. and 1,000 F. as step in further advance in economical steam-electric power generation

THE FIRST steam-electric station to use the high temperature of 1,000 F. at a pressure of 1,350 psi. will be the 30,000-kw. extension to the Missouri Avenue Plant of the Atlantic City Electric Co. This installation is a natural outcome of the 1941 extension No. 6 in which a 1,350-psi., 1,000-F. turbine was purchased, but the piping, valves and other 1,350-psi. pressure parts were designed for 950 F. because of insufficient faith in materials available for higher temperatures at that time. That this judgment was correct is borne out by difficulties with graphitization of carbon-molybdenum pipe which appeared early in 1943, two years after Unit No. 6 was placed in service. Since then, confidence in materials that have become available makes 1,000 F. possible. Chrome-molybdenum piping is being used, the high chrome content of 2 percent being amply sufficient to inhibit graphitization.

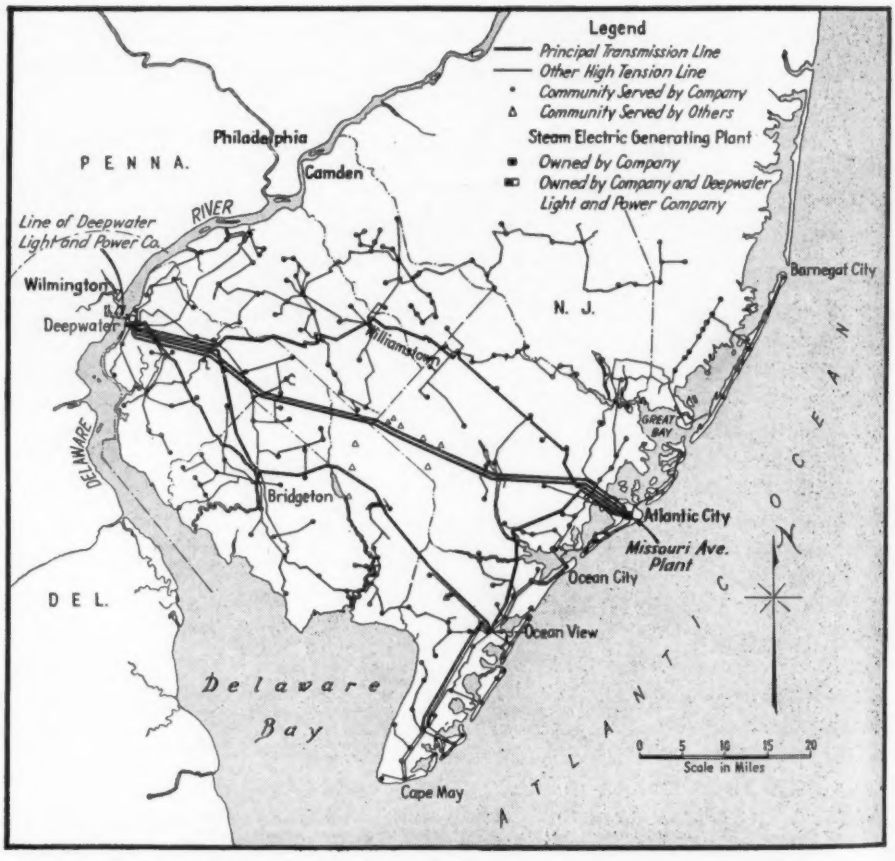


FIG. 1—Atlantic City Electric System serves southern portion of New Jersey

Unit No. 7 Addition

A single Foster Wheeler boiler rated at 310,000 pounds per hour will supply steam at 1,350 psi., 1,000 F. to a single-cylinder General Electric turbine having a nameplate rating of 25,000 kw. The unit is usually considered as 30,000-kw. capacity, as that capacity will be attained, even with a "dirty" turbine.

The turbine oiling system is one of the most advanced yet designed in that one turbine-driven and two motor-driven centrifugal pumps are used rather than gear oil pumps that are driven from the main turbine shaft. Any pump can be isolated by gate valves and removed from service for repair while the turbine is in operation.

One of the features in this station is the positive automatic control of final steam temperature by a condenser-heat exchanger in the saturated steam line between the boiler drum and superheater inlet header. In addition, radiant and convection superheaters tend to provide uniform temperature.

It is expected that the installation will be ready for service in the fall of 1946.

It was just about ten years ago that construction work was started on the 40,000-kw., 1,250-psi., 925-F. unit at the Logan Station of the Appalachian Electric Power Co. This was the first

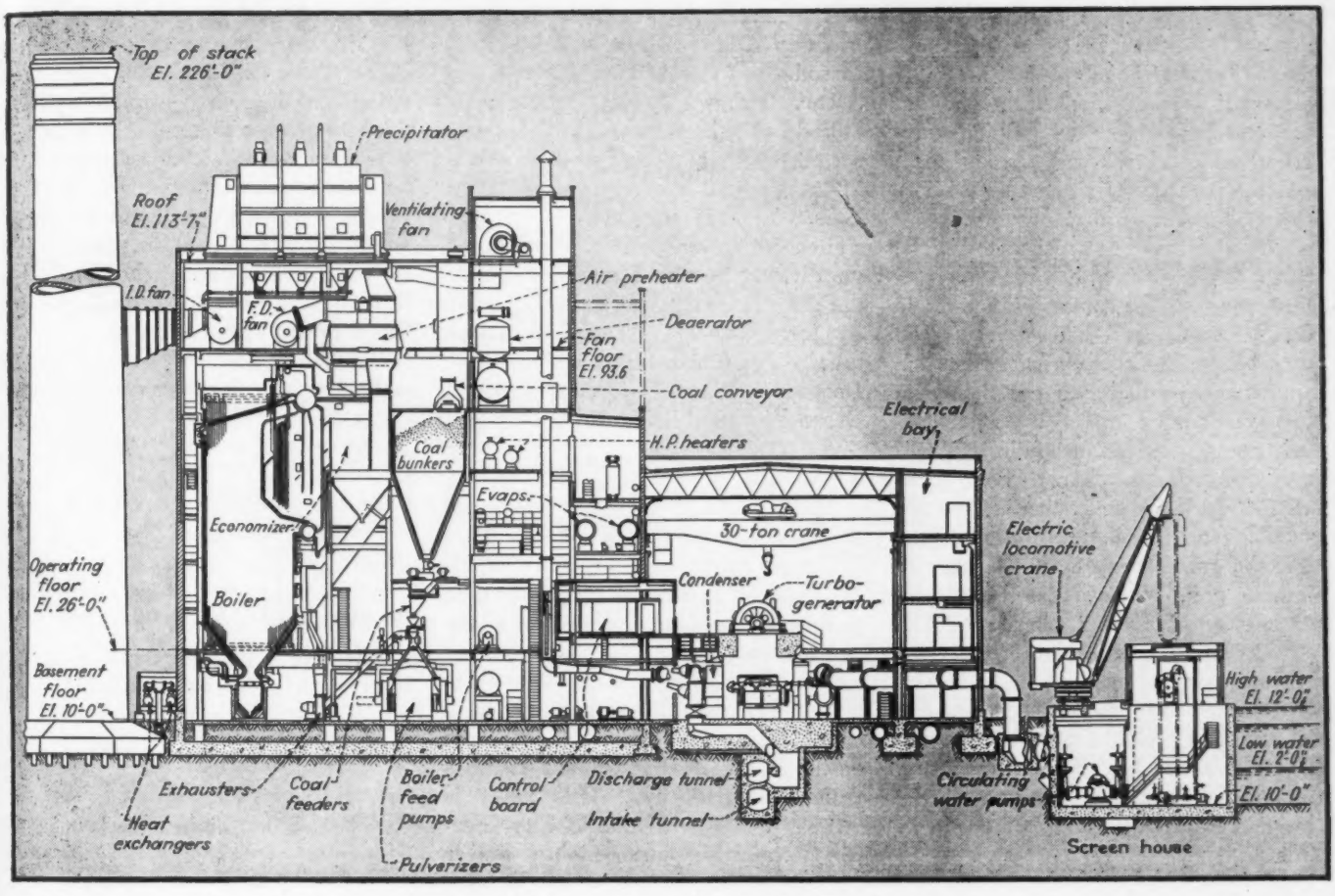


FIG. 2—Cross section at Unit No. 7 of Missouri Avenue Plant, Atlantic City Electric Co.

large 3,600-rpm. turbine-generator, and one of the first stations to use 925-F. steam temperature. Since that time many economic studies have been made with various combinations of pressures and temperatures, the highest pressure being 2,300 psi. at 940 F. at Twin Branch. The high temperature of 1,000 F. has finally been attained in this present extension at Atlantic City. For none of the approximately 1,000,000-kw. capacity in steam-electric stations that were designed and constructed by the American Gas and Electric Service Corp. during the last decade, were steam conditions lower than Logan's 1,250 psi., 925 F. The use of reheat was considered for most of these stations, and in the case of the 2,300-psi. unit at Twin Branch, reheat of 900 F. was used at a cross-over pressure of 400 psi.

Reheat Limitations

Use of reheat with small turbines, such as the 30,000-kw. unit at Atlantic City, is not economically justified. The 30,000-kw. turbine has a small casing and it would be most difficult to remove steam, reheat it and then return it into the same shell, particularly since a double-shell construction is necessary for the front end of a 1,000-F. turbine. The type of double-shell construction used will be described later in this article.

Reheat is entirely satisfactory and often economically justified for high-pressure turbines which are of such size that tandem or cross-compounding is required. In such large units, the problem of withdrawing and returning steam is greatly simplified by the fact that the high- and low-pressure elements are really separate turbines. Reheat is much less attractive in the single-cylinder, single-flow construction used in the 30,000-kw. size.

Hesitation to Exceed 950 F.

Progress in steam temperatures has been relatively slow during the last decade. Logan started out at 925 F.; this was again adopted at Windsor. A 2,300-psi. unit at Twin Branch then followed with 940 F.; the two units at Philo had 950 F., as did the two units at Cabin Creek and an additional unit at Twin Branch. Then Glen Lyn and Tidd had to drop back to 925 F. because these 100,000-kw., single-casing, 1,800-rpm. turbines could not be built with the double-shell construction used for 3,600-rpm. turbines which would permit 950 F.

Decision to go to 1,000 F. at Atlantic City for Unit 7 was made shortly after the height of the difficulties which were being experienced with graphitization in carbon-molybdenum steam piping at temperatures of 900 to 925 F. There was, therefore, some natural hesitation in going higher than 950 F. which was the highest steam temperature used up to that time. Although graphitization is not completely understood, it is believed that enough is known about it to avoid its occurrence in new piping. It had been known for many years that relatively small amounts of chromium would prevent graphitization. This was particularly well appreciated in the malleabilizing field where every effort had to be made to avoid traces of chromium. Therefore it was felt that chrome-molybdenum steam piping would avoid

danger from graphitization. The metallurgists of General Electric Co. conducted a thorough study into the materials available for the turbine casing and finally selected molybdenum-vanadium steel for the turbine shell.

The operating record of the boilers and steam temperature controls at the 950-F. level has been satisfactory. The effect of 950 F. on turbine construction appears to be solved by the double shell construction. Therefore, in the light of our 950-F. experience, the time appeared ripe to go to the next step in view of the confidence gained during our graphitization studies. There is in this a certain degree of appropriateness for a system that developed such advances as mouth-of-mine plants, the 600-psi. reheat cycle, large size topping units, hydrogen cooling of generators, and 2,300-psi. operation. The step to 1,000 F. at Atlantic City was felt necessary because fuel there is relatively expensive—more expensive than at any other plant on the American Gas & Electric Co. System. In other words, the economic factors were the preponderant influences involved in this decision.

The relation of the Missouri Avenue Plant in Atlantic City to the territory served by Atlantic City Electric Co. System is shown by Fig. 1. The plant is tied to the high-tension transmission system by four 66-kv. lines and to the 22-kv. system by a series of 22-kv. lines. Two of the 66-kv. lines (designed for future 132-kv. operation) go directly to the Deepwater Plant; the third line connects with Deepwater by looping north through Williamstown. The fourth line connects to the Deepwater Plant by looping south to Ocean View and Bridgeton.

Load Growth Expected

The load on the system is expected to reach 100,000 kw. at the time Unit 7 is expected to go into service in the fall of 1946, and it will be just in time to forestall an otherwise possible shortage in capacity.

The Deepwater Plant, the other major source of supply to the Atlantic City Electric Co. System, is located on the Delaware River, about 65 miles from Atlantic City. This plant is owned jointly by Atlantic City Electric Co. and Deepwater Light & Power Co., a subsidiary of the Philadelphia Electric Co. In the Deepwater Plant there are installed two 53,000 cross-compound condensing units. A 12,500-kw. process steam turbine exhausts at 400 psi. to a series of evaporators which furnish 200-psi. process steam to the E. I. du Pont de Nemours Co., Inc. Another 20,000-kw. unit operating with 100 percent makeup exhausts directly at 200 psi. to furnish process steam to the same company.

When the new unit, No. 7, is installed the station will have the following units:

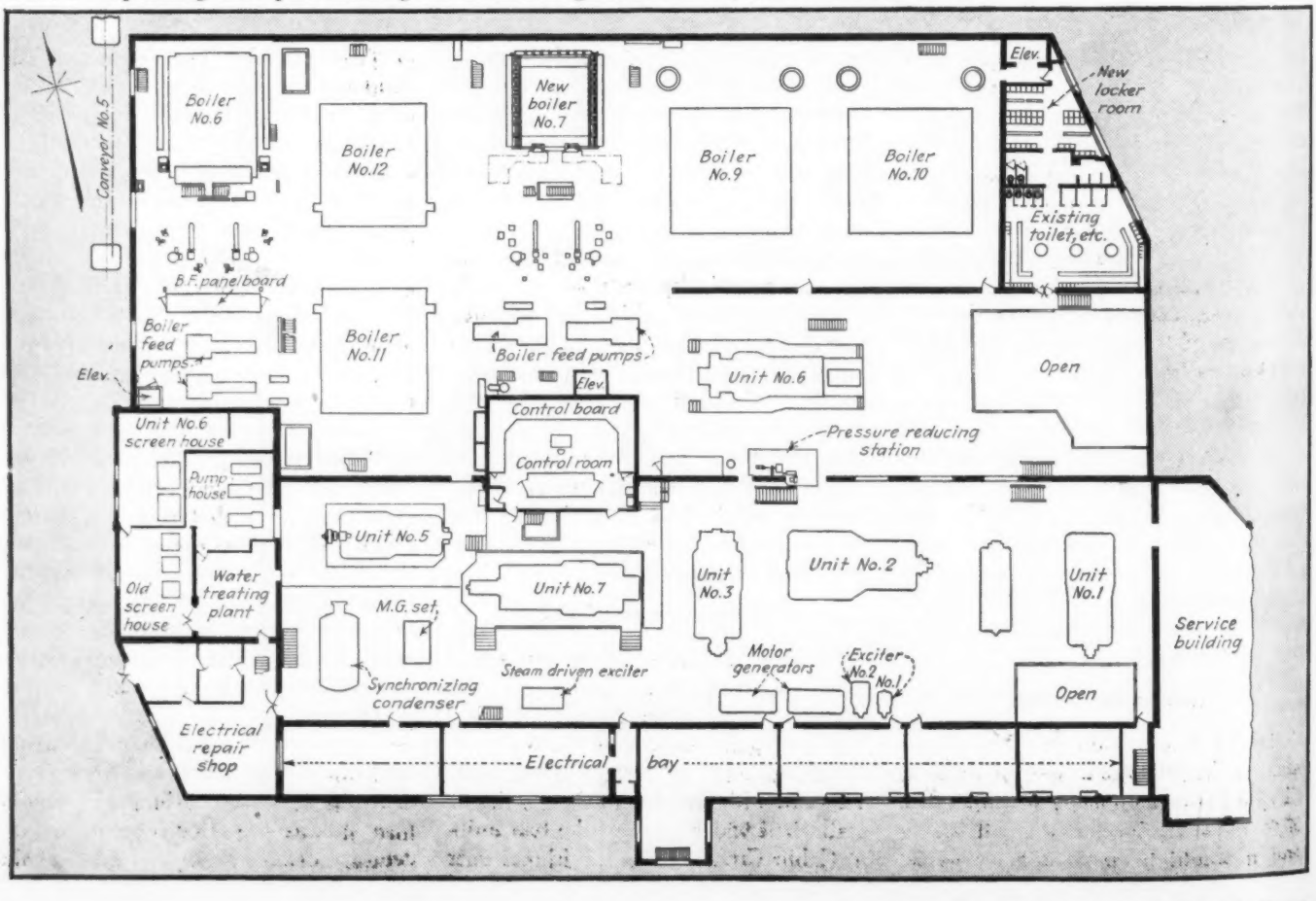
UNIT NO.	KW. CAP.	PRESS.	OPER. TEMP.
7	30,000	1350	1000
6	30,000	1350	950
5	10,000	260	650
3	10,000	260	650
2	15,000	260	650
1	10,000	260	650
Heating	2,000	260	650

The layout of these units is shown by Fig. 2, a cross-section of Unit 7, and by Fig. 3, a plan of the plant operating floor.

The Heat Cycle

Fig. 4 shows the heat cycle adopted for Unit 7 which is very similar to

FIG. 3—Operating floor plan showing all six turbine-generator units, boilers and auxiliaries



that previously employed on the earlier Unit 6. There are four stages of extraction to three closed heaters and one deaerating heater. The latter operates at a positive pressure even with loads as low as one-fourth of maximum so that vacuum equipment is unnecessary for the extraction of noncondensible gases from the deaerator shell.

The upper limit of pressure is held to under 60 psia. in order that full advantage is taken of the A.S.M.E. Boiler Construction Code for Unfired Pressure Vessels. The drips from the high-pressure heaters and the evaporator are all cascaded to the deaerator so that no water is delivered to the boiler which has not been degasified under positive pressure in the deaerator. This precaution is supplementary to deaeration in the main condenser and assures by positive means that oxygen-free water is always supplied to the boiler.

The cycle for Unit 6 differs from that shown for Unit 7 in that steam is extracted from turbine No. 6 to meet process steam demands and steam for heating district hot water. The newer unit will not serve these heating operations and the two units are treated as separate entities. Because of the high makeup requirements on turbine 6, all water introduced into that system is chemically treated. With Unit 7, however, there seemed to be every justification to avoid any chemical problems so that makeup evaporators will be employed.

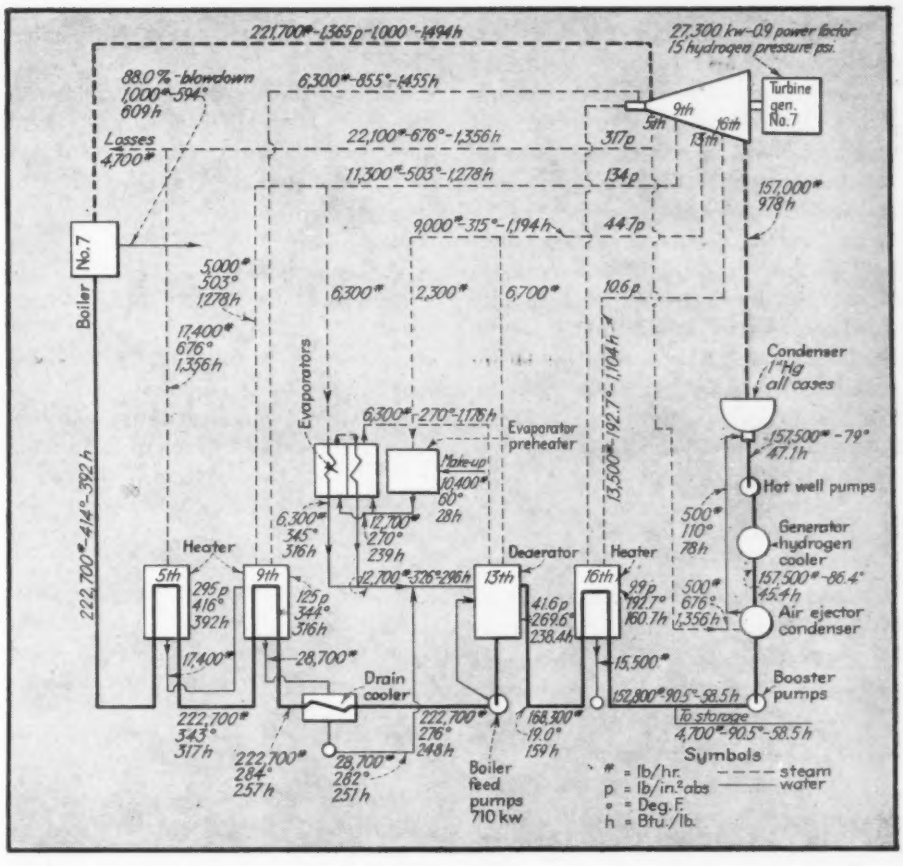


FIG. 4—Heat balance for 27,300-kw. generation of turbine-generator at unity power factor and with 15-psi. hydrogen cooling

Evaporator Operation

The size and method of operation of the evaporator equipment is somewhat novel. There are two evaporators served by a single preheater. The two evaporators can be operated in parallel as single-effect equipment, or in series as double-effect equipment. If high capacity is demanded the evaporators are run single-effect, but if thermal efficiency is the objective then the evaporators will be run double-effect. Experience with evaporators which are inadequate is not uncommon with the result that operators must resort to makeshifts in order to have adequate distilled water on hand, especially at low loads. With the projected installation, a high percentage of makeup can be produced even under light load conditions, and it will not be necessary to cut back on the next lower bleed point in order to maintain capacity. In the calculations shown in Fig. 4, double-effect operation is anticipated and at an extreme rate of 4⅓ percent at maximum load.

The expected thermal performance on the basis of the allowances included in Fig. 4 is shown in Fig. 5. These data indicate that Missouri Avenue Unit 7 should have no trouble in bettering a plant performance figure of 11,000 Btu. per kw.-hr. when measured from fuel pile to station send-out.

Boiler Design

The new Foster Wheeler No. 7 boiler (Fig. 6) serving the 1,000-F. turbine-generator in Missouri Avenue Plant Atlantic City Electric Co. is quite similar to existing boiler No. 6 which has operated very satisfactorily since September 29, 1941 (almost five years), in that the pulverizers and firing equipment, furnace, and boiler generating surface arrangement substantially duplicate the earlier installation. The radiant-convection superheater is the outstanding feature of the new boiler as it is rated to produce 1,000-F. steam temperature over a range extending from 130,000 to 310,000 lb. of steam per hr.

Positive automatic control of final steam temperature is accomplished by means of a condenser-type heat exchanger, primarily for temperature control during load swings. Fig. 7 shows the oversized superheater inlet header with two tube bundles arranged in parallel circuits. Steam on the shell side is condensed by boiler feedwater at about 400 F. flowing through the tubes, which precludes contamination of the steam. The condensed steam passes into the superheater elements along with the non-condensed portion and is re-evaporated in passing along to the radiant superheater section.

Temperature Control

Steam temperature is controlled by varying the quantity of water passing through the tubes. Final superheating occurs in the convection section. The amount of condensing necessary is kept to a minimum, in spite of the wide control range of 130,000 to 310,000 lb. per hr., by the inherent compensating characteristics of the radiant and convection sections, permitting superheaters of commercially practical sizes.

Water flow through the heat exchanger condenser tubes is controlled by a motorized valve which receives impulses both from temperature and boiler gas flow. The condenser was located ahead of the radiant superheater rather than between superheaters in order to take advantage of the greater heat transfer from saturated steam to the radiant tube surface. A relatively small condenser is satisfactory since the condensation of 1 percent of the steam will reduce the outlet steam temperature by approximately 10 F., heat input to the surfaces remaining constant.

Metal Specifications

The superheater material specifications are as follows:

(a) Inlet header (heat exchanger shell) —(SA266-GR. 1) Carbon steel forging.

(b) Inlet header (heat exchanger tubes)—Cupro-nickel.

(c) Intermediate headers — (SA266-GR. 1) Carbon steel forging.

(d) Outlet header.—(SA158-P3b) 2 percent Cr, 0.5 percent Mo.

(e) Radiant wall tubes—(SA213-T16) 4-6 percent Cr, 0.5 percent Mo, 0.4 Ti.

(f) Radiant inlet tubes — (SA-192) Carbon steel.

(g) Convection section tubes.

Initial 2 loops—(SA209-T1) Carbon-moly steel

Intermediate 1½ loops — (SA213-T16) 4-6 percent Cr, 0.5 percent Mo, 0.4 Ti

Final 1½ loops—(SA213-T19) 17 percent Cr, 9.5 percent Ni, 0.8 percent Cb.

The superheater tubes are welded to stub end tubes which are shop-welded into the headers. A minimum number of bolted handhole openings are provided in the headers for inspection purposes.

The furnace is completely water and steam cooled; the high rate of heat absorption is designed to preclude slagging, even with coals having ash fusion temperatures of 2,200 F.

A complete complement of air-driven steam soot blowers, including furnace wall blowers, is provided. Operation is remote automatic with selective sequential control from a single control panel.

An electrostatic precipitator, designed for high collection efficiency, is provided before the induced draft fans as was done on the previous unit in this station.

Double Shell Turbine

The high-pressure turbine, made by the General Electric Co., is rated at 25,000 kw., 3,600 rpm. with a 27,778-kva., 0.9 p.f., three-phase, 60-cycle, 11,000-volt, hydrogen-cooled generator. The turbine throttle conditions are 1,350 psig., 1,000 F.; the rated back pressure is 1 in. Hg absolute. Even with the high throttle temperature of 1,000 F., there will still be over 11 percent moisture in the exhaust.

It has the double-shell construction that was originally developed for the 40,000-kw. topping turbine at Logan. However, the adoption of double-shell construction to condensing type units was first accomplished on Atlantic City turbine No. 6 which was placed in operation in September, 1941. The turbine has 19 stages; the first stage wheel is of double-row construction, the remaining wheels of single-row construction.

Special provisions were made to avoid any possible warping of the emergency stop valve when welding the main steam lead and four control valve leads to it. Twelve-inch lengths of chrome-molybdenum piping are being factory welded to the inlet connection and the four control valve outlets while the valve is still in the rough-machined stage. After full-furnace stress relieving, the valve will be finally machined and the trim assembled therein. Thus, all field welds to the valve will be far enough away that the high-stress-relieving temperature will not affect any of the close fits.

Governor Control

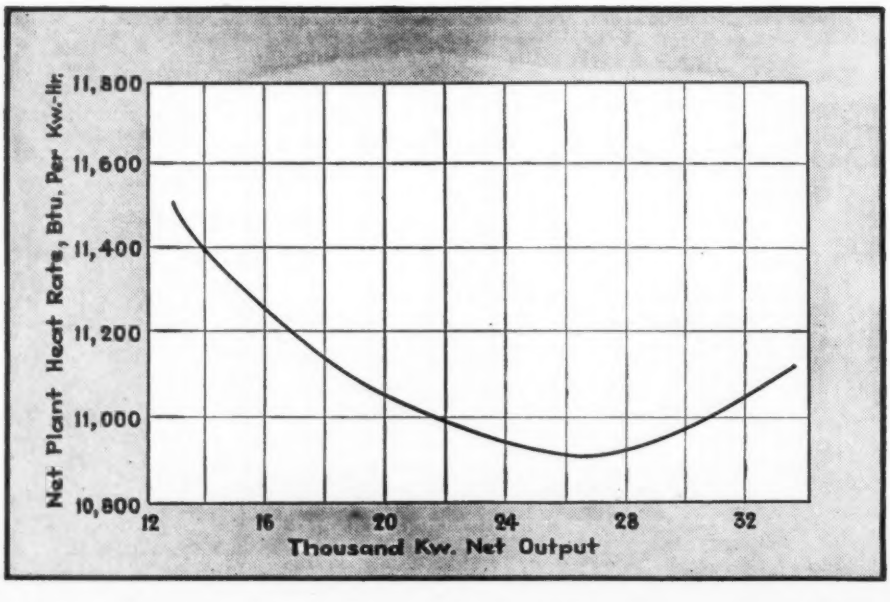
The operating governor will be the new rotating-pilot-valve type which avoids the wear usually experienced, as the oil relay pilot valve is directly connected to the governor weight spindle and rotates with it. This assures freedom from sticking of the pilot valve, a reduction of lost motion since there are no intermediate levers, and improvement in sensitivity.

This turbine is the first to have an under-speed release on the governor. When a highly efficient turbine is connected to a large system, it may be desirable for economic purposes to run it at a fixed load with the control valves positioned by handwheel so that they will not respond to normal small variations in frequency but will revert to speed governor control in case of abnormal frequency swings. The under-speed release mechanism accomplishes this function. It is designed for remote control in the electrical control room.

Ten Control Valves

There are ten control valves, five in the upper half shell and five in the lower half shell, to obtain equal distribution of heating and minimum shell distortion. Eight valves admit steam to the first stage nozzles and two valves bypass steam from the first stage to the third stage. With this arrangement,

FIG. 5—Expected thermal performance is substantially better than 11,000 Btu. per kw.-hr., measured from fuel pile to station send-out



initial boiler pressure and temperature never penetrate the turbine further than the first stage valve chest, and all other parts of the turbine are protected by the temperature drop incident to the flow through the first stage.

There are two vertical, motor-driven centrifugal oil pumps (75 hp.) each of full capacity; an auxiliary vertical turbine-driven oil pump and a small motor-driven oil pump (7½ hp.) for emergency operation.

Centrifugal Oil Pumps

This is the first turbine to have centrifugal oil pumps instead of gear type pumps, giving a power saving of 40 hp. Spring-loaded baffle or relief-valves are avoided; such valves cause undesirable aeration of the oil.

Normally, oil is supplied by one of the two 3,600-rpm., motor-driven centrifugal pumps at about 175 psi., the other acting as a spare. An unusual and desirable feature of the layout is a gate valve in the discharge of either pump to permit removal for repairs while the turbine is in operation. Pressure switches are provided in the control system for each of these pumps so that the spare pump starts automatically in the event of failure of the other pump.

A turbine-driven centrifugal pump backs up the main motor pumps. It is controlled by an oil-operated regulator sensitive to hydraulic header pressure. If the main motor pumps fail, the resulting drop in oil pressure operates this regulator and brings the turbo-pump up to speed immediately to provide oil for the control oil header and bearings. This pump will hold a slightly lower control oil pressure than the main pump due to the inherent regulation of the pump regulator. It is possible to hold the bearing pressure right up to normal by the oil bypass around the baffle valve.

Bearing Protection

Additional protection for the bearings is provided by a small direct-current, motor-driven, centrifugal pump which discharges into the bearing header ahead of the cooler. This is called the emergency bearing pump and automatically starts in case of low bearing pressure.

On the front of the sliding standard of No. 1 bearing there are mounted the following switches having alarm contacts:

(a) Switch for automatically starting both the main and emergency bearing oil pumps from the 25-psi. bearing oil line.

(b) 175-psi. hydraulic pressure alarm switch to close contacts on subnormal pressure.

The following switches are located on the oil tank:

(a) 25-psi. bearing alarm switch to close contacts on subnormal bearing pressure.

(b) Pressure switch to indicate operation of steam pump.

(c) Pressure switch to indicate operation of emergency bearing pump.

Oil Fires Minimized

Particular attention was paid to the oiling system to minimize the hazard of oil fires. The main oil tank is sunk in the floor to oil level so tank rupture could not cause overflow.

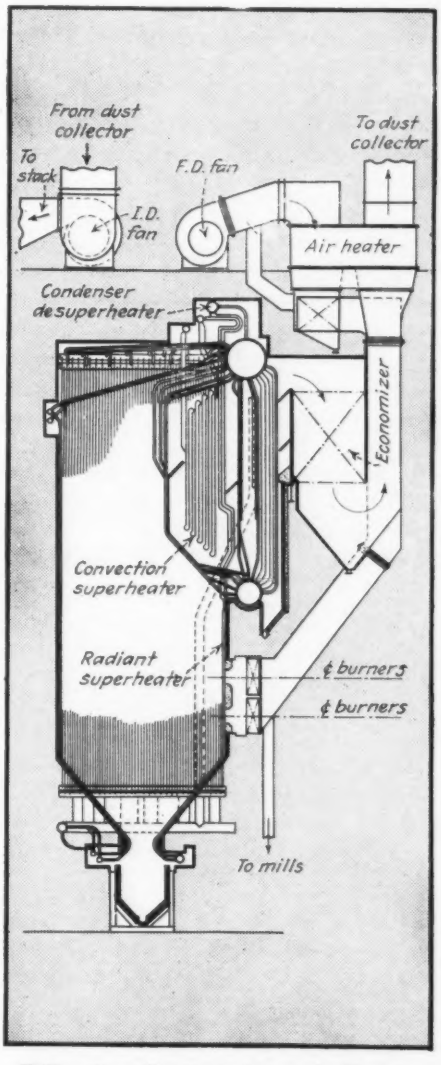


FIG. 6 — Cross-section of Foster-Wheeler boiler with radiant-convection superheater to produce 1,000 F. steam over range 130,000—310,000 pounds per hour

In addition to the usual accessories furnished with turbines, the extra features that appear in the following list were also obtained:

1. The emergency stop valve is provided with a solenoid-operated test valve, and with solenoid trip and reset. It has a selsyn transmitter to indicate its position on the turbine operating board. Solenoids permit the following functions:

Remote tripping of the stop valve emergency trip,

Remote resetting of the stop valve emergency trip,

Remote operation of emergency governor oil trip valve.

2. The synchronizing motor has two speeds, a single slow speed in the direction to open the control valves, but in the closing direction the motor has a first as well as a slow speed. A solenoid brake eliminates coasting and assures accurate positioning.

3. An eccentricity recorder provided with alarm contacts operates when the eccentricity is excessive at running speed.

4. A vibration recorder with alarm contacts indicates excessive vibration at running speed.

An initial pressure regulator is provided to close the steam admission valves to the turbine in case of sudden drop in the boiler pressure. It serves the double purpose of protecting both turbine and boiler from sudden temperature changes.

Piping for 1,000 F.

Because this station is the first to be designed for normal 1,000-F. operation at high pressure, a great deal of thought had to be given to the selection of the steel for the main steam lead. After a detailed consideration of all the materials available, the final selection was grade T-22 of A.S.T.M. specification EA-A-213a-44, and rolled to A.S.T.M. Specification A-206-44T including supplementary requirements. This selected material has the following analysis:

	Percent
Carbon-maximum	0.15
Chromium	2 to 2.50
Molybdenum	0.80 to 0.95
Manganese	0.30 to 0.60
Silicon-maximum	0.50
Phosphorus-maximum	0.04
Sulphur-maximum	0.04

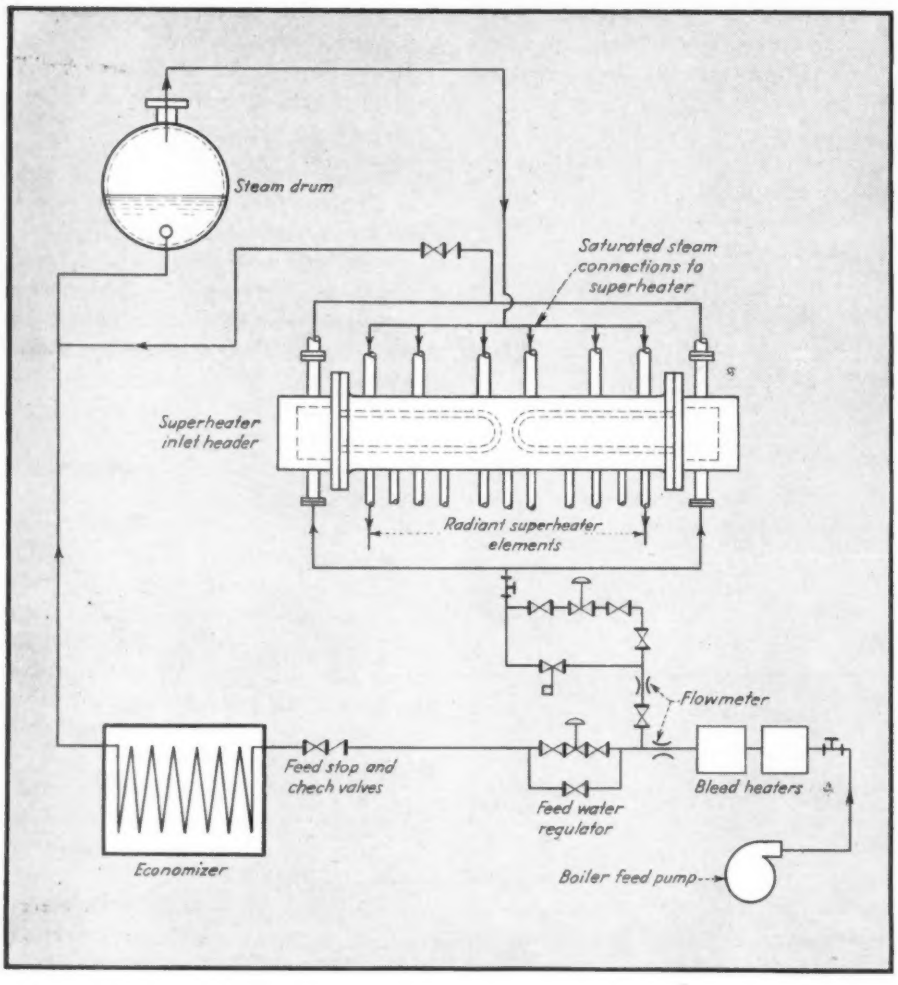


FIG. 7—Heat exchanger for controlling the steam temperature

The tubing has been made by the Timken Roller Bearing Co. at Canton, Ohio, and is now being fabricated by the Grinnell Co.

The main steam gate valve being made by the Lunkenheimer Co. is their new alloy WL which has the following analysis:

	Percent
Carbon	0.24
Silicon	0.45
Manganese	0.68
Nickel	0.70
Chromium	0.61
Molybdenum	0.67
Phosphorus	0.034
Sulphur	0.030
Copper	0.06

As it is a single boiler-turbine installation, no boiler non-return valve is required; only a single gate valve is provided between the boiler and the turbine emergency stop valve.

Electrical Features

The simplified one-line diagram, Fig. 8, shows the manner in which the generator of Unit 7 will be connected. The output is carried to both the 66-kv. and 22-kv. systems by means of a bank of two 24,000-kva., 3-phase transformers in contrast to the connection of Unit 6 to the 22-kv. bus only by an auto-transformer. The 3-phase transformers were chosen because of the combination of flexibility of maintenance, operation and economy of construction. Connections between the generator and the transformers as well as those between the transformers and the 22-kv. bus will be by means of high-voltage, gas-filled cable.

The generator installation is novel with respect to the use of an amplidyne regulator, this being the first application of such equipment on a major steam-driven unit.

The auxiliary system is independent of the rest of the station and is considered a part of the generator unit with which it is associated. Emergency connections are made, however, to other plant auxiliary power sources to insure reliability under all conditions. Auxiliary switchgear for both 2,300-volt and 440-volt service are metal-clad units.

The electrical control of Unit 7 and its associated equipment will be located on switchboard panels in the main control room under supervision of the operator who will also supervise the boiler operation. All generator control for the plant will be concentrated in this room. Control for 22-kv. and 66-kv. outgoing feeders, transformer connections, and functions other than those associated directly with generators, together with the control for the distribution feeders, will all be made automatic in operation and located by itself in a room separate from the main control room of the station.

Centralization of Control

The control arrangement permits centralizing responsibility in a single individual, who has before him all pertinent data and indications required in a full cycle from lighting-off the boiler to shutting down. This centralization precludes several operators working at cross-purposes during upset cycle conditions, or while attempting to restore load following a trip-out.

A centralized control room has been located between the boiler and the turbine rooms. This room contains all controls for Unit 7, the turbine controls for Unit 6, and the electrical control for five older units.

The development of telemetering has greatly facilitated the concentration of all indications and controls in one location. In the past, restrictions of constant slope for tubing serving flow meters and level recorders would have rendered the present compact arrangement almost impossible. In addition, the number of high-pressure water and steam connections within the control room is held to a minimum, reducing the probability of damage to electric controls and wiring from small leaks.

Combustion Control

The all-electric combustion control consists of a master element which imposes a loading voltage on the solenoids of the various control regulators. Boiler air flow is controlled by inlet vanes on the induced draft fan and fuel input by regulating the exhauster inlet dampers. In order to effect satis-

factory control of furnace draft over a wide load range, regulation is performed by an additional damper in the forced-draft fan outlet ahead of the air heater, while the inlet vanes of the fan are controlled to maintain a constant differential across the regulating damper.

While the coal level in ball mills is frequently controlled by intermittent type feeders it was felt that an appreciable variation in mill output and possibly in the output fineness may result. Accordingly, constant-speed table feeders with variable shear plates were provided, in which the position of the shear plate is controlled by a motorized regulator responsive to the usual differential taken from the coal and mill suction reference lines.

Heat Cycle Control

Control throughout the heat cycle follows closely the practice of Unit 6. Condensate is stored cold, in a 60,000-gal. tank outside the building. Admission of condensate to the cycle and sending it to storage are accomplished by remote-operated air-loaded valves, both under the normal control of the operator. Aside from the deaerator storage tank which is maintained at a relatively constant level, no surge tank for hot condensate is provided.

Since the occasion for starting the unit with no outside steam available is at least a possibility, a connection from the boiler drum is arranged to provide steam to the air ejectors and deaerator, and is sized to supply these services from the time that drum pressure reaches 400 psi. The same drum connection is used to provide soot-blowing steam.

Level Recorders

To obviate the difficulties encountered with high-pressure, float-type drainers, the two high-pressure heaters and their common flash tank have been provided with level recorders of the differential type containing pilot valves for air operation of the drain valves. This arrangement provides the operator with a full picture of the conditions in the drain cycle and has proved satisfactory in the five years it has been in operation on Unit 6. A study made for Unit 6 showed that this type of control can be provided for approximately the same cost as float-operated drainers alone, which provide no indication to the operator.

Completion of this unit will provide the Atlantic City system with an additional 30,000 kw. (bringing the total up to 60,000 kw.) of very economical high-pressure, high-temperature capacity at the Missouri Avenue Plant.

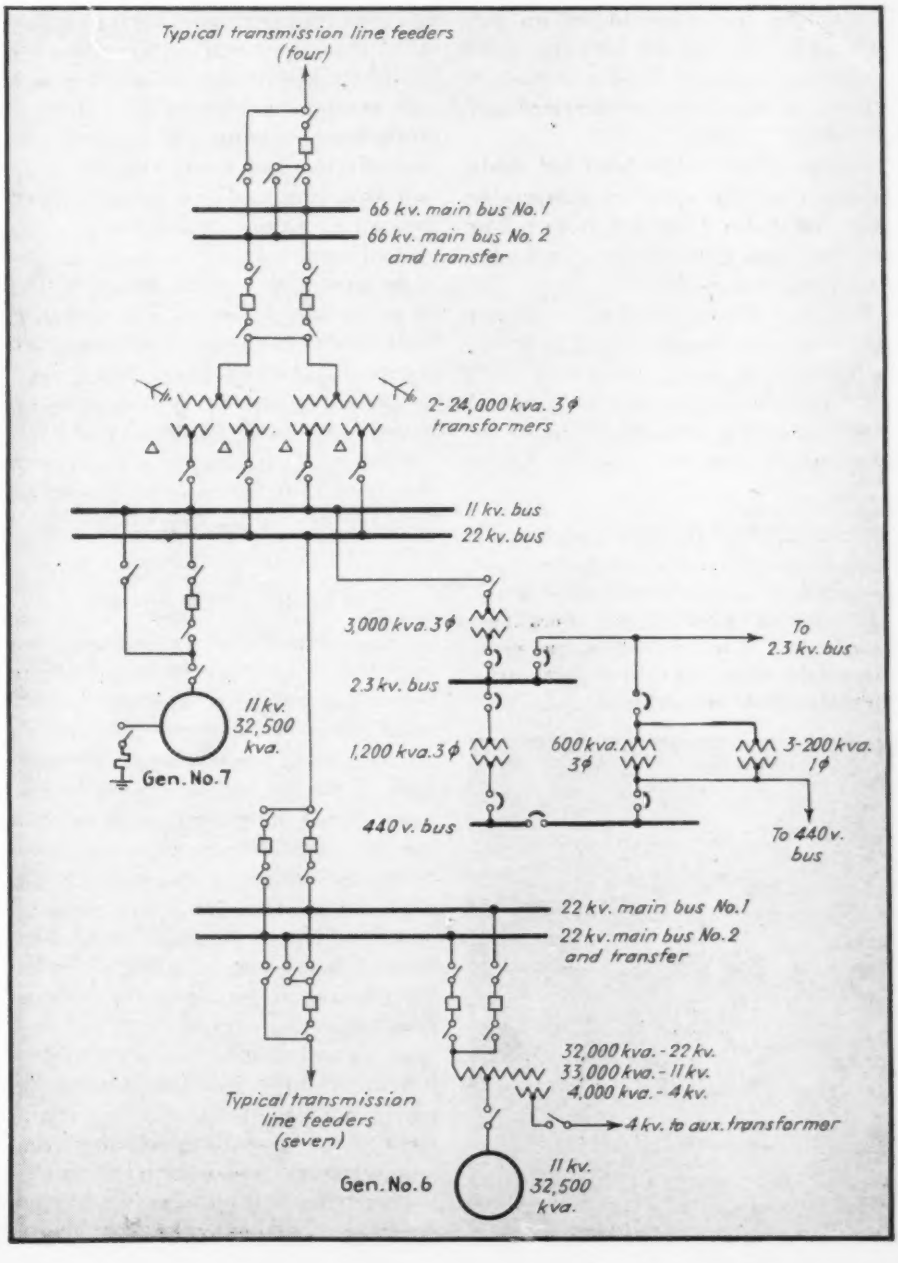
This capacity together with Deepwater will carry the base portion of the rapidly expanding load of Atlantic City Electric Co.

The 47,000 kw. of low-pressure, low-temperature generating units will not only provide capacity for load building and moderate load factor use, but because it can readily be taken out of service, it is ideally adapted for use as either hot or cold standby capacity. This, in short, will give a well balanced arrangement of capacity over the full range of load factor and also will provide a most efficient operating setup.

Acknowledgment

The author wishes to express appreciation to his staff members, T. Baumeister, T. Frankenberg, E. H. Krieg, F. A. Lane, and L. Schueler, who have contributed material that was utilized in the preparation of this article.

FIG. 8—Electrical one-line diagram shows auxiliary system for Unit 7 independent of the rest of the Missouri Avenue station


Typical transmission line feeders (four)
66 kv. main bus No. 1
66 kv. main bus No. 2 and transfer
2-24,000 kva. 3φ transformers
11 kv. bus
22 kv. bus
3,000 kva. 3φ
To 2.3 kv. bus
2.3 kv. bus
11 kv. 32,500 kva.
Gen. No. 7
1,200 kva. 3φ
600 kva. 3φ
3-200 kva. 1φ
440 v. bus
To 440 v. bus
22 kv. main bus No. 1
22 kv. main bus No. 2 and transfer
32,000 kva. - 22 kv.
33,000 kva. - 11 kv.
4,000 kva. - 4 kv.
4 kv. to aux. transformer
Typical transmission line feeders (seven)
Gen. No. 6
11 kv. 32,500 kva.

This MODEL SUBSTATION Can Simulate Any Fault

P. E. SMITH, *Power Supervisor, Public Service Co. of Northern Illinois, Chicago, Ill.*

Used for job and refresher training of substation operators this miniature substation, energized at 500 volts d.c., can simulate any fault or switching problem and give correct indications and clearances. Provides true metering; has adequate and correct relaying on all equipment

A MINIATURE SUBSTATION that performs exactly like a real one—even to relaying properly under fault conditions and giving correct control indications—has grown out of the need, in our job and refresher training courses for substation operators, for a "visualizer" that would add a note of realism to operating demonstrations.

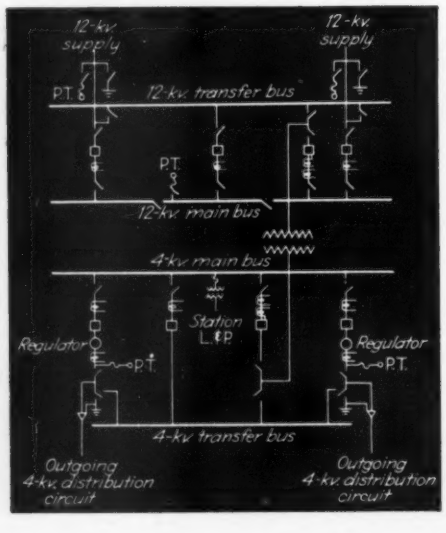
It was obviously impractical to interfere with the operation of an actual functioning substation to set up job training problems for trainees. The only recourse was to build a miniature substation that would be energized and that would "work."

The problem looked hard but study showed that there were no insuperable obstacles if direct current from power rectifiers was used as the supply for energizing the model.

Result of the experiments in design is shown in accompanying illustration. In addition to its simulation—to scale—of actual substation and switchboard appearance this model is capable of adequate and correct relaying on all equipment as well as true metering. It has interlocking circuits corresponding with those on real equipment. Its feeder voltage regulators perform in a true manner, at least to the extent of producing circulating and charging current effects. And it can simulate fault and switching problems giving correct indications and clearances on its switchboard.

Because it is possible to apply and clear various types of bus and line faults and perform actual switching operations on the model and have it react properly, its use has been equally instructive for both experienced and new operators, often doing more to help them recognize infrequent occurrences than any amount of discussion or theorizing.

ONE-LINE DIAGRAM—Circuit arrangement of model substation was selected to permit demonstration of all types of switching and operating problems. Note that 12-kv. bus can be sectionalized into three parts and transfer buses are included



A Distribution Substation

The model simulates a substation fed from two 12-kv. cable lines and having two 4-kv. regulated distribution circuits. This arrangement provides all the switching combinations and problems of the biggest station on the system and can therefore be used to demonstrate all standard operating procedures. As shown in the one-line diagram the main bus can be sectionalized into three parts. Both 12-kv. and 4-kv. transfer buses were included to broaden the number of problems that can be demonstrated.

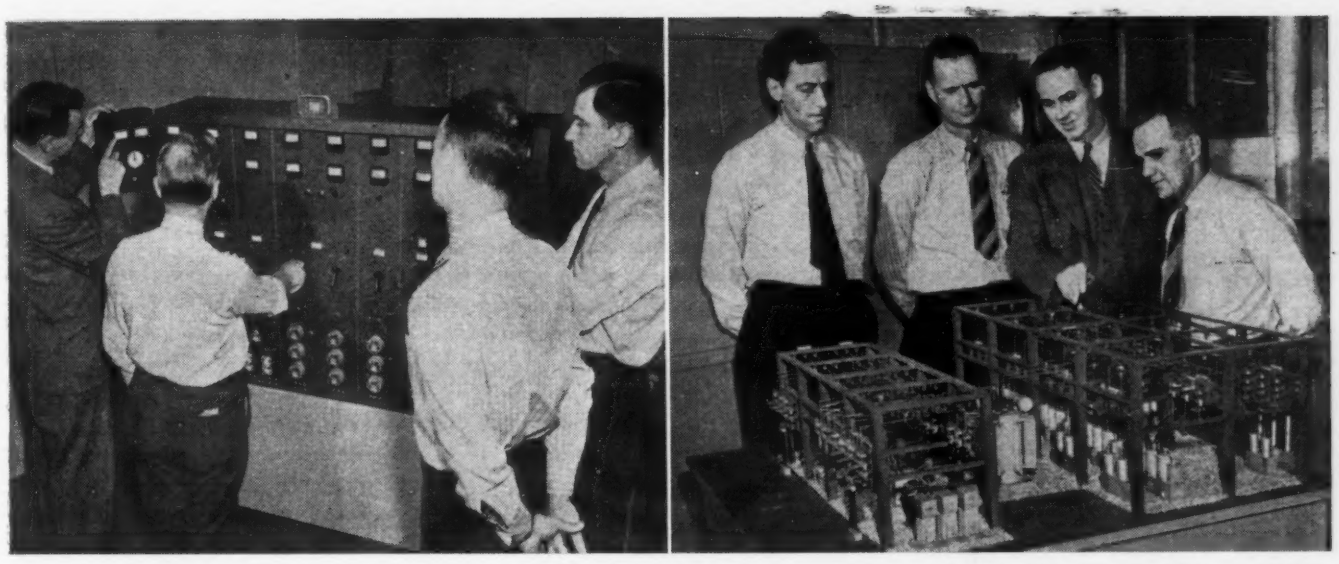
A conventional eight-section switchboard, of about half size, houses the major portion of the working equipment of the substation including main and regulator power supplies, protective relaying and interlocking circuits, metering, functioning breaker operating handles, indicating lights, station light and power circuits, etc. A 66-conductor cable connects it with the "outdoor" substation structure.

With the exception of the synchroscope, all meters on the switchboard are d.c. vane-type milliammeters or d.c. voltmeters equipped with either a dropping resistor or shunt so that true metering is had on all loads. While the miniature synchroscope will not produce a rotating beat, it will perform all other indications. Also on the scope panel are the scope lights and 12-kv. bus and line voltmeters.

Miniature over-current, reverse-current and differential relays on the 12-kv. portion of the switchboard are equipped with targets to show which relay operated. Separate alarm and indicating lights for the 12-kv. and 4-kv. sections of the board are on the station light and power panel. All tripped relays in each voltage class must be reset before the alarm can be turned off. The transformer differential relay operates both of the alarms as it trips both high and low-side oil circuit breakers.

The power rectifier, supplying the model, is capable of delivering 200 ma. at 500 volts d.c. over the two incoming 12-kv. lines. Regulation on this supply was purposely made poor above 200 ma. to protect the rectifier tubes and power supply equipment and also to prevent injury from accidental contact with energized equipment.

Relaying under fault conditions obtained in the model and the realistic indications obtained make the student forget the miniature size of the equipment. Midget instantaneous overcurrent relays are the basic relays used in



SWITCHING OPERATIONS—Instructor, left, points to bus voltmeter on scope panel as "student" prepares to close breaker connecting transformer primary to the 12-kv. main bus. All meters, indicating lights, breaker controls function and give proper operating indications as do miniature CR, CO and CA relays below. . . . Closing a Disconnect (Right)—Using an insulated miniature "hot-stick" instructor operates a disconnect switch in the "12-kw." portion of the substation. Energized at 500 volts d.c., regulators, circuit breakers, and disconnect switches simulate performance of real equipment. Disconnect switches are realistically when opened under load. Two incoming cable lines supply the 12-kv. section (right). Two regulated distribution circuits tap the 4-kv. portion. Sectionalizing switches and transfer buses are included

the model. These were altered to include timing elements as needed. For example, time to heat the filament of a 100-watt lamp in parallel with the transformer low-side overcurrent relay and raise its resistance above that of the relay coil is enough to differentiate between a 4-kv. bus fault and a 4-kv. circuit fault. In main overload relays simulating the generating station circuit breakers the lamp was bypassed by a doorbell buzzer to get slower timing.

Model Relays

Reverse current relays were simulated by polarized relays with the permanent magnet portion on one line being fed from the opposite line ahead of the structure. Operation is similar to that obtained on common cross-connected scheme of relaying on parallel lines.

The differential relay on the transformer is a double-winding relay with one coil fed from the high side "current transformer" and the other side fed from the low side "current transformer." Either coil being fed alone will cause the relay to operate and trip both high and low-side curcuit breakers on the transformer. With a reversal of one feed or with one coil carrying less than 50 percent of the load passing through the other, the relay will operate as before.

Circuit breaker operation is simulated with standard 110-volt d.p.d.t. relays. An insulated arm on each operates three sets of ¼-in. contacts serving as the circuit breaker. These contacts will not break short-circuit current unless they are bypassed by the condensers. The normal relay contacts were used for pilot light indication and operating and sealing in circuits. A sealing-in circuit was added to hold the circuit breaker closed.

Since the entire load carrying system operates on direct current the transformers are strictly models. The three "phase" leads are looped through the main distribution transformer, forming a solid connection between 12-kv. and 4-kv. buses when the transformer circuit breakers are closed. In the case of current transformers "A" and "C", phase leads are looped straight through while the "B" phase lead is the common positive lead and is used for all metering and relaying.

The model outdoor induction regulators have a hand-controlled worm drive that turns the quadrant gear. This gear has a visible scale connected to the shaft of a variable resistor beneath the table. An additional d.c. power supply was added for each feeder to produce circulating and charging current to demonstrate the necessity for setting regulators on neutral during a transfer bus operation and to illustrate the hazards in picking up or dropping regulator charging current with disconnect switches. The variable resistor regulates the amount of circulating current and the circuit relays are adjusted so that they will trip during a transfer bus operation if the regulator is more than 1 percent off of neutral.

Job Training Course

Refresher courses range in length from a minimum of one to a maximum of five days depending on the aptitude and experience of the students. During this training period the range of standard operating procedures and problems is reviewed using the model. Intermittently the students are given a quiz by the instructor. Each trainee in turn is asked to leave the room while the demonstrator sets up an operating condition on the model substation—bus fault, equipment failure or whatever. Upon his return the student is checked to see how soon he can recognize the trouble from switchboard indications alone and restore service to normal.

To complete the training picture, load records are provided on which actual loads are recorded, "hold" cards and "special order cards" are filled out and placed when taking equipment out of service. A station log is kept on all switching and service interruptions and switching is dispatched by the instructor to teach telephone procedure.

500-Mile, 230-Kv. Series Compensated Transmission

S. E. SCHULTZ, Chief Engineer, Bonneville Power Administration

Bonneville studies theoretical and practical aspects of series capacitance in long 230-kv. lines as solution to power transmission from remote hydro developments

IT HAS LONG been recognized that a problem basic to the development of hydroelectric resources of the Pacific Coast is the economical transmission of bulk power over long distances. Until recently the ceiling for such transmission for practical purposes has been around 300 miles, as exemplified by the Boulder and Coulee lines. Need for even longer lines to reach water power sites now under consideration has led engineers of the Bonneville Power Administration to an intensive study of the whole problem of high-voltage, long-distance power transmission.

In approaching the problem, consideration was given to conventional a.c. transmission at voltages from 230 to 350 kv.; studies were made of the possibilities of d.c. transmission; and an investigation was conducted of 230-kv., a.c. lines using series compensation. In addition a review was made of available information regarding plans in this country and abroad for use of extra-high voltage transmission of both direct current and alternating current. Need for further research and certain high development costs ruled out serious consideration of d.c. transmission. Although one of the large manufacturers has expressed views that presently developed equipment for 287 kv. might possibly be suitable, with some modifications, for voltages in the region of 350 kv., nevertheless the possibilities of accomplishing the desired results more economically with series compensation of 230-kv. lines in the Northwest led engineers of BPA to undertake a study of this approach to the problem.

As a result of this study, it appears possible to transmit as much as 175,000 kw. per 230-kv. circuit a distance of approximately 500 miles at a cost, predicated on 1940 values, of approximately 1¼ mill per kilowatt-hour, on the basis of deliveries at substantially 100 percent load factor. This cost provides for appropriate charges against transmission losses and an allowance of approximately 9 percent to cover fixed charges and operating and maintenance expenses. Of course, firm power deliveries could not be assured over a single long-distance, 230-kv. compensated circuit, but neither could they be assured over a single higher voltage circuit where the vulnerability would be similar but the cost greater for equal amounts of power carried. It is also felt that, for the needs of the area served by BPA, two low-cost 230-kv. lines with series compensation will transmit as much energy as two 330-kv. circuits, with greater economy and flexibility.

230-Kv. Advantages

Among the specific considerations favoring the use of 230-kv., rather than higher voltage long-distance transmission, the following are important:

1. It represents an expansion of the existing 230-kv. system.

2. It permits the serving of intermediate loads through the use of lower-cost substations. This is an important consideration inasmuch as it has been the experience of BPA that a number of transmission circuits that were originally intended as trunk lines actually became local service lines because of the development of intermediate loads.

3. It makes possible low initial investment, permitting the installation of capacitors at a later date.

4. The problem of design and the stringing of conductors for voltages above 230 kv. are comparatively complicated. At 230 kv., the conductor is substantially a compact or solid cable. At higher voltages, hollow conductors or possibly multiple conductors per phase must be employed to minimize corona and radio interference.

5. Relatively low-cost wood pole construction is practicable at 230 kv. Studies indicate that higher voltages would require more costly steel construction.

6. 230-kv. transmission circuits can be maintained with the lines energized. Such practice would be more difficult at higher voltages.

The theory of compensating the reactance of long lines with series capacitors to increase transmission distances has been known for some time. Series compensation introduces a number of new problems of design and operation, but the need for long-distance transmission and the economic practicability of series compensation suggests efforts to evolve an early solution.

These problems arise from the manner in which reactance compensation is introduced into the transmission system. Capacitors are connected in series with the transmission line at intermediate stations and neutralize a portion of the line reactance. With decreased reactance under normal operation, increased power can be transmitted. However, during line faults the fault current produces excess voltage across the capacitors, which makes it necessary to have them taken out of service instantaneously during fault periods. As long as the capacitors are out of service transmission capabilities are reduced. Thus it is necessary to reinsert them into the transmission line as rapidly as possible after the fault has been cleared. Relay time and circuit breaker clearing time as well as time required for reinserting the capacitors after a fault is cleared are all more important than in a conventional system as far as stability is concerned.

The necessity for protecting the capacitors during a fault and then restoring them into the line in the shortest possible time after a fault has been cleared is one of the major problems

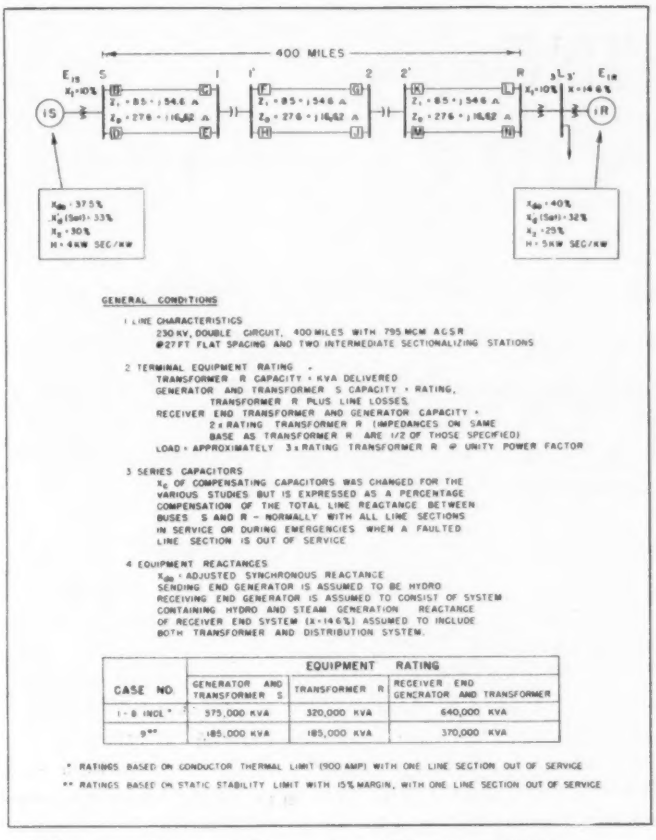

400 MILES
GENERAL CONDITIONS
1 LINE CHARACTERISTICS
230 KV, DOUBLE CIRCUIT, 400 MILES WITH 795 MCM ACSR
@27 FT FLAT SPACING AND TWO INTERMEDIATE SECTIONALIZING STATIONS
2 TERMINAL EQUIPMENT RATING
TRANSFORMER R CAPACITY = KVA DELIVERED
GENERATOR AND TRANSFORMER S CAPACITY = RATING,
TRANSFORMER R PLUS LINE LOSSES
RECEIVER END TRANSFORMER AND GENERATOR CAPACITY =
2 x RATING TRANSFORMER R (IMPEDANCES ON SAME
BASE AS TRANSFORMER R ARE 1/2 OF THOSE SPECIFIED)
LOAD = APPROXIMATELY 3 x RATING TRANSFORMER R @ UNITY POWER FACTOR
3 SERIES CAPACITORS
Xc OF COMPENSATING CAPACITORS WAS CHANGED FOR THE
VARIOUS STUDIES BUT IS EXPRESSED AS A PERCENTAGE
COMPENSATION OF THE TOTAL LINE REACTANCE BETWEEN
BUSES S AND R - NORMALLY WITH ALL LINE SECTIONS
IN SERVICE OR DURING EMERGENCIES WHEN A FAULTED
LINE SECTION IS OUT OF SERVICE
4 EQUIPMENT REACTANCES
Xdv = ADJUSTED SYNCHRONOUS REACTANCE
SENDING END GENERATOR IS ASSUMED TO BE HYDRO
RECEIVING END GENERATOR IS ASSUMED TO CONSIST OF SYSTEM
CONTAINING HYDRO AND STEAM GENERATION REACTANCE
OF RECEIVER END SYSTEM (X=146%) ASSUMED TO INCLUDE
BOTH TRANSFORMER AND DISTRIBUTION SYSTEM.
CASE NO.
EQUIPMENT RATING
GENERATOR AND TRANSFORMER S
TRANSFORMER R
RECEIVER END GENERATOR AND TRANSFORMER
1 - 8 INCL.*
375,000 KVA
320,000 KVA
640,000 KVA
9**
185,000 KVA
185,000 KVA
370,000 KVA
* RATINGS BASED ON CONDUCTOR THERMAL LIMIT (900 AMP) WITH ONE LINE SECTION OUT OF SERVICE
** RATINGS BASED ON STATIC STABILITY LIMIT WITH 15% MARGIN, WITH ONE LINE SECTION OUT OF SERVICE

FIG. 1 — Characteristics of a 400-mile, 230-kv. compensated transmission system

Summary of Stability Studies

1. Case No.		1	2	3	4	5	6	7	8	9
2. Constant Percent Compensation. See Item 6 (Before and After Fault)	Initial %	60	63	63	65	66	75			
	Final %	60	63	63	65	66	75			
3. Constant Ohmic Value of Compensation (Before and After Fault. No Additional Compensation Added on Removal of Fault)	Initial %							100	100	0
	Final %							75	75	0
4. Compensation Removed During Fault		No	No	Yes	No	Yes	Yes	Yes	Yes	—
5. Compensation Reinserted After Start of Fault (Cycles)		—	—	7.0	—	7.0	10.5	7.0	10.5	—
6. Additional Compensation Added After Start of Fault (Cycles). (Equally at Both Capacitor Stations.)		7.0	7.0	7.0	10.5	7.0	10.5	—	—	—
7. Initial Loading at Receiver End (kw./1,000)		311	324	324	325	314	315	324	324	150
8. Initial Operating Angle Between E_{is} and E_{ir} (Deg.)		32.5	34	34	34.5	29	24.5	12.5	12.5	28.5
9. Maximum Angle of Swing (Deg.)		102	91	Unstable	Unstable	91	98	102	Unstable	91.5
10. Shunt Reactor (Kvar/1000)*		—	—	—	—	109	113	114	114	—

* Installed at Point (1') see Fig. 1 to reduce maximum voltage at Bus (1) and to neutralize a portion of line charging current and decrease current flowing in Section S-(1) below thermal limit.

Fault Type, Location, and Clearing Time: Two phase to ground at Point 1 (See Fig. 1). Near end cleared in 3.5 cycles, far end in 7.0 cycles.

to be solved. The ultimate characteristics desired of the protective equipment would be the equivalent of a lightning arrester across the capacitors which would flash and short circuit the capacitors when the voltage across them reached a critical value and would seal off during the first half cycle following removal of the fault, or upon reduction in voltage below the critical value.

Another major problem, that of protective relaying, grows out of the fact that it is necessary to install capacitors in a few large units rather than the ideal condition of distributing them in small units uniformly along the line. The main reason for the few large units is that the capacitors have to be protected during system faults as outlined, and the additional cost of protective equipment for a large number of small units would be prohibitive. Moreover, the cost for a given total capacity would be greater if installed in small units.

When capacitors are installed in relatively large units, directional relays in the line will see a *capacitive* impedance for some fault locations but an *inductive* impedance for other fault locations after the protective equipment has shorted the capacitors. Hence, present directional relays with phase characteristics normally used would operate improperly for some fault locations. With phase characteristics changed to the optimum angle, certain fault conditions would produce slow relay operation and poor contact closing operation, since they would be operating close to zero torque position.

Present impedance relays would also fail to interpret the distance of the fault from the relay in all cases. These unusual relay problems are inherent in the series compensated system when the capacitors have to be installed in a few relatively large units.

Current Balance Relays

Current balance relays, on the other hand, should function normally in a series compensated system providing there are parallel line sections of equal impedance. This means that capacitors would have to be installed external to the parallel line sections in Fig. 1.

The amount of power which can be transmitted from a practical standpoint without loss of stability presents the major design and operating problem of a long transmission line. This problem becomes complicated when series compensation is employed, because capacitors and system service must be protected during faults. During the fault period the system must function without the benefit of series compensation, thereby causing an increased tendency for synchronous equipment on the system to fall out of step. Therefore, it is extremely important, much more so than in a conventional system, to clear the fault and to restore conditions to normal in the shortest possible time. Consequently, in operation of a series compensated system, emphasis must be placed upon efforts to obtain optimum performance of protective relays, circuit breakers and capacitor-protective equipment.

Discussions were recently held at the International Conference in Paris, attended by the writer, on Large Electric High-Tension Systems. Engineers in this country and abroad are working on high-voltage, d.c. transmission and extra high-voltage, a.c. transmission. While considerable progress has been made and further development should by all means be continued, it is the opinion of BPA engineers that series compensation is one of the most promising means of achieving low-cost delivery of electrical energy over long lines and its further investigation should be pursued.

Oxidation Testing of Transformer Oils . . . II†

Small commercial distribution transformers used in simulated field service test involving standard runs at 85 deg. C. and cycling runs in which temperature is allowed to drop 2 days out of each 14 days

WILLIAM G. HORSCH, *Socony-Vacuum Laboratories*, Paulsboro, N. J.*

STEPS WERE TAKEN to offset the weaknesses of the short-time, small-scale laboratory oxidation tests by developing a simulated field service test in which commercial transformers are used. After a preliminary trial of various sizes of transformers and modes of operation, a procedure and technique were developed which are highly satisfactory except that the time involved is long.

All conditions are carefully controlled. In the present work, temperature, type of transformer, nature of coil treatment, and degree of exposure of the oil to the atmosphere, all have been held constant. There is considerable acceleration over most commercial operation. Also, a test started at any time is directly comparable with another test started at the same or any other time. Results that have been obtained with the simulated field service test have made it possible to draw a number of conclusions regarding the applicability or non-applicability of a number of laboratory oxidation tests.

Certain departures from the adopted "standard" conditions of operating were studied in order better to orient the test and also to serve as a basis for deciding whether any changes should be adopted in future work. Three such sets of experiments are described here. However, the importance of intercomparison with previous runs thus far has outweighed other considerations and the method as perfected about ten years ago is being maintained.

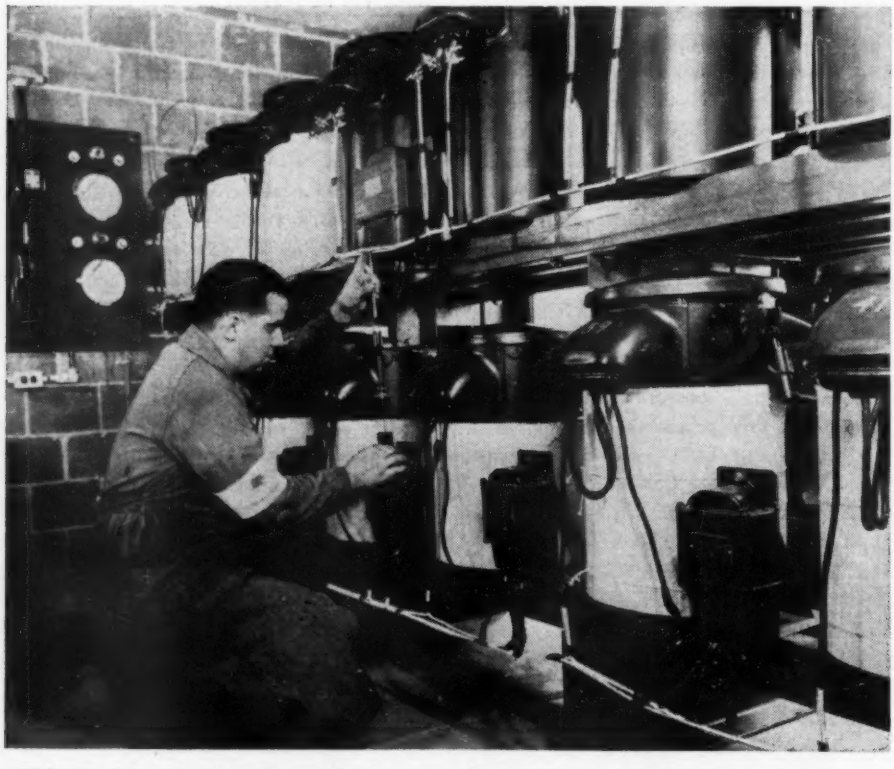


FIG. 5—Four banks of distribution transformers used in eleven-year simulated field service test of transformer oil sludging

Effect of Water

Water often enters transformers in commercial service and remains for various periods and in various amounts depending on the transformer's location and the oil-servicing regime practiced by the operating company. Apart from its effect on dielectric strength, the presence of free water increases the catalytic activity of iron and quickly produces disagreeable sludging. Acceleration of the aging of high-grade commercial oils is illustrated by the two examples in Table II and Fig. 7, and amounts to roughly five to ten-fold that of the dry oil. The sludge deposited on the core of the transformers containing water was much greater in 17 months than in the dry transformers in eight years.

Cycling Runs

In the standard runs the temperature is held continually at 85 deg. C. and the transformer lids are raised uniformly about ⅛ in. so that air may enter freely. The object of the cycling runs was to simulate the fluctuations in temperature that occur in the field and at the same time maintain controlled conditions. In these experiments the

* Research and Development Laboratories, a Division of Socony-Vacuum Oil Co., Inc.

† The preceding instalment appeared in August 3 issue of Electrical World, page 54.

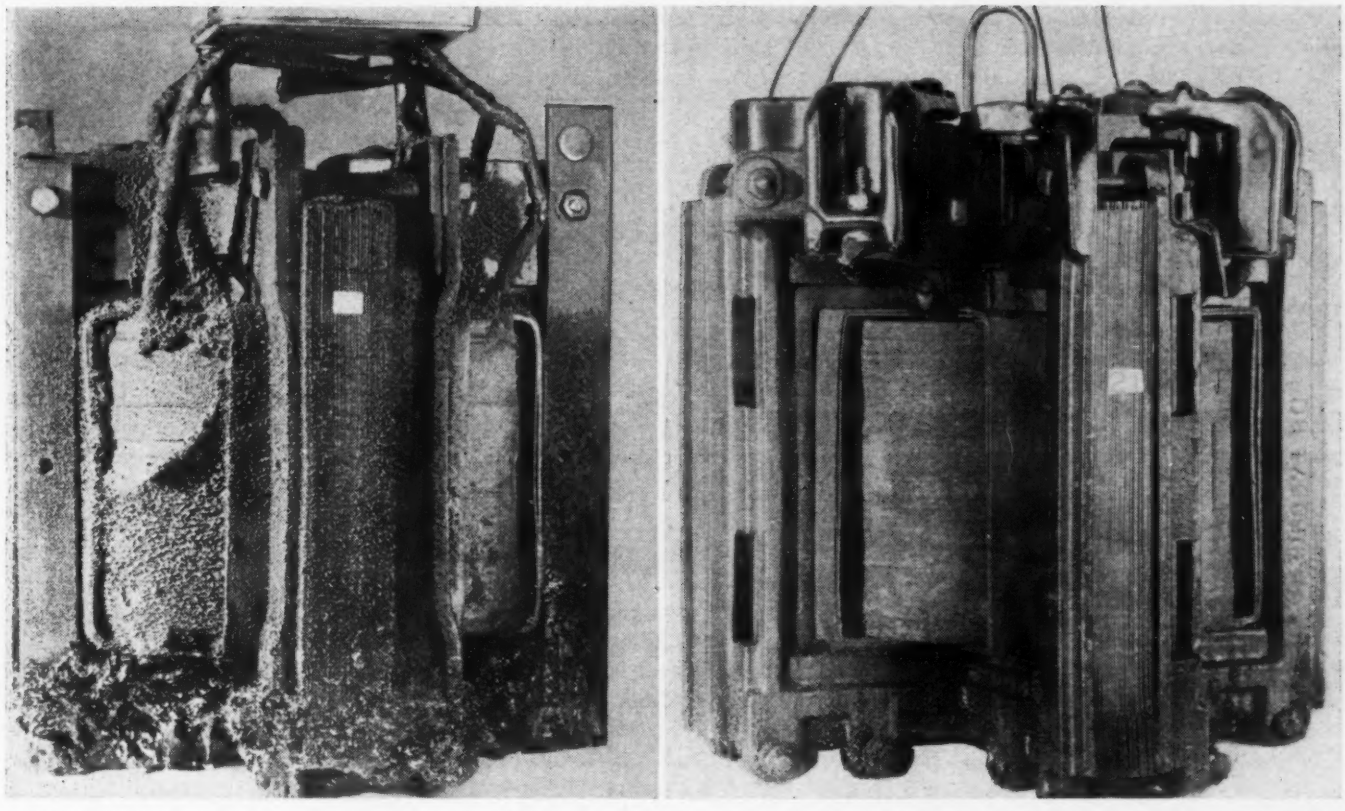


FIG. 6—Appearance of core of transformer (left) after 17 months' operation with ½-in. depth of water using high-grade oil; (right) after 100 months' operation in high-grade commercial transformer oil; both at 85 deg. C top-oil temperature

current was on for twelve days followed by two days with the current off, repeated throughout the run. Equilibrium top-oil temperature with the current on was 85 deg. C., ambient temperature, 50 to 55 deg. C. While the current was off, the transformers were exposed to substantially outdoor air. For this reason, in these preliminary tests, the low-temperature limit of the cycle was lower in winter than in summer, a condition which should be avoided were the procedure to be adopted for regular running.

Results Compared

The results of two runs of this type are shown grapically in Fig. 8, in comparison with regular runs with the same brands of oils. Notwithstanding the fact that due to the cycling operation the oil was at operating temperature only about 86 percent of the time, the deterioration was more rapid in the breathing than in the standard runs. Based on neutralization number the acceleration due to breathing was fully twofold. Since the acceleration began in the early part of the run it would appear that the renewal of the air in the space above the oil was more rapid. In the early stages also, the color rose at about the standard rate, later falling

Table II

Simulated Field Service Tests with Water in Bottom of Transformer

(Depth of Water Approximately ½ Inch)

OILS: HIGH-GRADE COMMERCIAL, NO.		101		102	
TEST CONDITIONS	MONTHS ON TEST	WATER PRESENT	DRY (STANDARD RUN)	WATER PRESENT	DRY (STANDARD RUN)
Neutralization Number Mg. KOH/G.	Start	0.03	0.03	0.06	0.03
	6	.41	.18	2.6	.20
	12	1.5	.27	5.3	.28
	24	3.6	.39	9.0	.45
	36	5.8	.54	11.0	.68
Specific Gravity, 60°/60°F.	Start	0.885	0.890	0.881	0.884
	6	.889	.890	.889	.884
	12	.891	.890	.889	.885
	24	.894	.891	.900	.886
	36	.899	.892	.903	.888
Viscosity at 100°F., Saybolt U. Sec.	Start	56	57.6	56	56.8
	6	64	61	71	60
	12	73	64	84	61
	15	79	.....	90	.....
	24	87	70	104	66.5
	36	102	75	123	72.5
Color, Lovibond	Start	0.2	0.25	0.2	0.3
	6	17	15	30	9
	12	67	32	50	20
	24	85	67	55	15
	36	114	105	90	71
Oil-Soluble Sludge, Wt. %	Start	Nil	Nil	Nil	Nil
	1	Nil	.....	0.03	.....
	6	0.02	0.01	.15	0.01
	12	.16	.015	.43	.02
	24	.10	.04	.26	.05
	36	.31	.08	.66	.08
Petroleum Ether-Insoluble, Wt. %	Start	Nil	Nil	Nil	Nil
	1	Nil	.....	0.05	.....
	6	0.05	Nil	.23	Nil
	12	.17	0.01	.71	Nil
	24	.33	.03	98	0.03
	36	.77	.06	1.6	.06

behind, due to the polymerization reactions which result in the precipitation of sludge. The appearance of the cores after four years that the test was run suggests that sludge precipitation was of the same order as in a standard test run.

Exclusion of Air

Runs are in progress which show very strikingly the effect of (a) restricting and (b) practically excluding the oxygen from the gas space above the oil. In a one-year period, after the oxygen had been swept out with nitrogen and with the lid clamped tightly against the gasket, the neutralization number of the oil rose to one-half that in a run with the identical oil and the same kind of transformer freely open to the air. At the same time changes in such other properties as color, viscosity, and resistivity, were less by the same or even greater amount. Runs in which the oxygen was partially restricted showed intermediate results. The degree of exposure to air therefore is an important factor in the rate of deterioration of the oil.

Standard Procedure

Simulated field service test procedure was adopted about 1934 after a number of preliminary runs with various-sized transformers and conditions of operating and after consultation with engineers of leading manufacturers of transformers. The transformers selected were 1.5-kva. capacity commercial transformers, 2,300/230 volts, supplied with over-sized tanks to take an initial oil charge of 5 gal. They do not necessarily represent the construction of transformers in use at the present day. Loading is by a feeding-back connection so that normal voltage stresses prevail, while only the energy corresponding to the losses need be supplied. The current circulated through the individual transformer averages about 120 percent of the rated value.

Instrumentation

A temperature controller-recorder, with its temperature-sensitive bulb submerged in the oil of one transformer of a bank of up to 16 transformers, causes the current to be varied automatically within a small range in order to maintain the oil at the desired temperature (85 deg. C. top-oil). On account of the comparatively high rate of heat dissipation of such small transformers, a certain amount of lagging is placed on the outside of the tanks, although the amount is kept from being excessive by employing an ambient temperature lying between 40 and 50 deg. C. The amount of lagging is adjusted on the individual transformer so that all shall operate at the same temperature, experience having shown that this adjustment, once made, is essentially permanent.

Before the test proper is started, the transformer is cleaned by charging sufficient of the test oil to cover the core (about 3½ gal.) and running for one week at regular test temperature. This oil is discarded and the full test charge of 5 gal. put into transformer.

Samples of oil are removed at periodic intervals during a run and their properties determined.

At the conclusion of a run, the oil is drained thoroughly, the core removed from the tank, and core and interior of tank photographed. Following this, any deposit present is scraped from the core and tank interior and weighed and analyzed for petroleum and sludge content. To accomplish this, a representative portion is washed on a Gooch crucible with A.S.T.M. naphtha, dried and weighed, then treated with acetone and the insoluble matter weighed and deducted. From the result the total grams of deposited sludge in the transformer may be calculated.

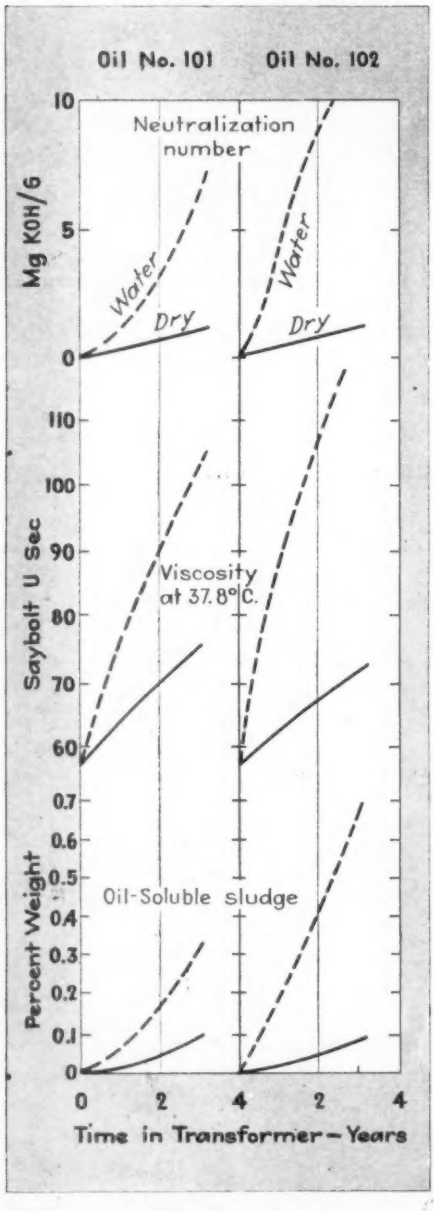


FIG. 7—Acceleration of oxidation in transformers due to the presence of ½-in. depth of free water

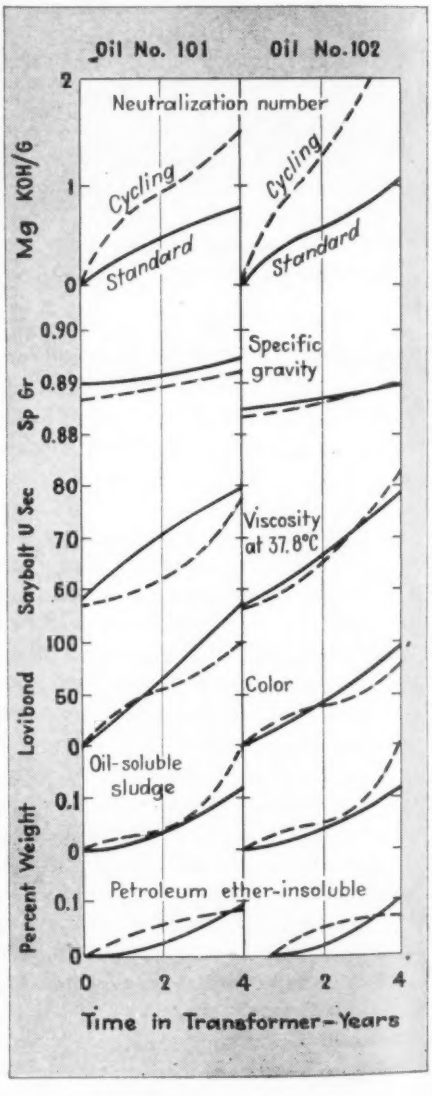
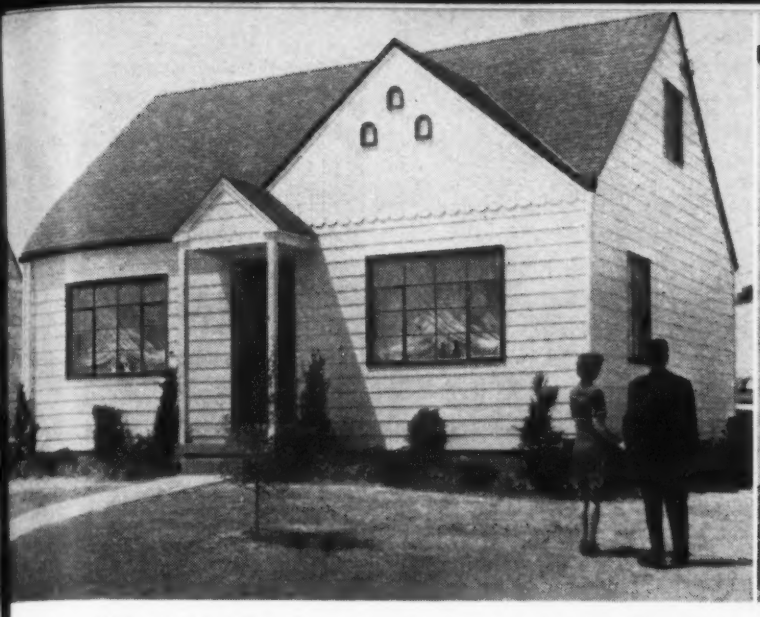


FIG. 8—Comparison of cycling and standard runs in SFS test. Cycling runs differ from standard runs only in that current was cut off and temperature allowed to drop to approximately outdoor value for 48 hours out of each two weeks



ONE of six different exterior designs in home-building program. Electric kitchen is 8 ft. 10 in. x 9 ft. 6 in., with range, refrigerator, dishwasher, and disposal unit installed. Laundry in basement contains washing machine and water heater

Utility Promotes HOME-BUILDING PROJECT

In cooperation with builder and electrical manufacturer, power company takes lead in program to erect 1,000 all-electric homes in towns of western Pennsylvania. Mortgage includes cost of appliances

IN THIS MONTH of August, 1946, 56 small homes, fully equipped for modern electrical living, will be completed in Masontown, Pa. This group of homes is part of 110 being built at that location and is the first unit in a total of 1,000 to be erected in western Pennsylvania. Over half of these will be in the service territory of the West Penn Power Co. The project is the result of cooperation between the utility; the builder, George C. Brown Co.; and the supplier of electrical equipment and appliances, the General Electric Co. The general contractor is the Mellon-Stuart Co.. William C. Young, architect.

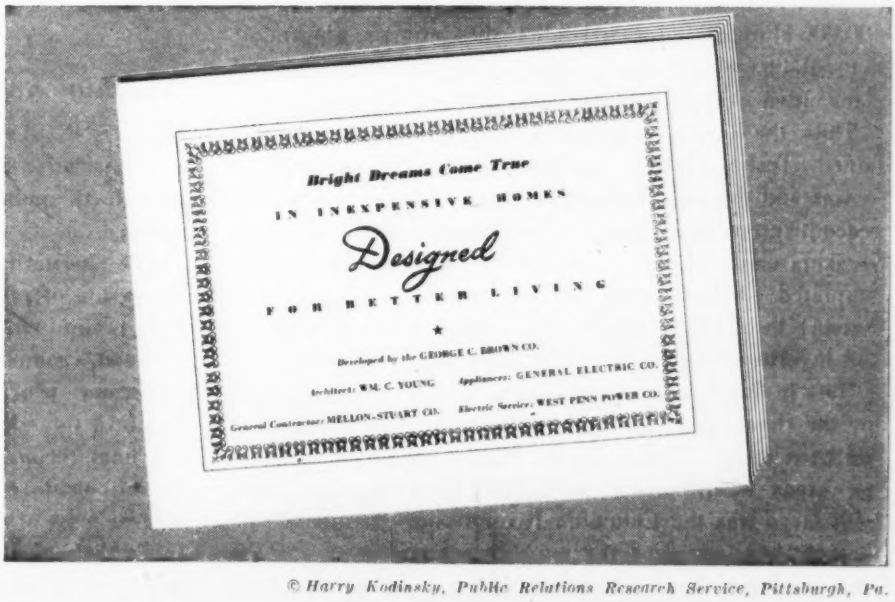
The homes are varied in six different exterior designs, all based on the same full basement plan with living room, dining room, bedroom, kitchen and bath on the first floor, and unfinished second floor with space for two additional rooms. Wiring and heating facilities for the second floor are in place and the stairway to it is finished.

Certified Red Seal wiring assures full availability of electricity for modern lighting and for the use of appliances throughout each house. Installed electric appliances are range, refrigerator and sink with dishwasher and garbage disposal unit in the kitchen, and in the basement laundry are water heater and washing machine.

The houses are selling at from $8,100 to $8,300. Sales preference is to veterans who can buy on monthly payments of $51 to $53 over a 25-year period. The cost of all the installed electric appliances is included in the selling price and purchase mortgage.

Indicative of the emphasis on the electrical features of the home is the fact that in the sales brochure whose title page is reproduced here, four of the 16 pages describe the electric kitchen and laundry and the wiring.

TITLE PAGE of brochure describing homes to be built



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EDITORIALS

S. B. WILLIAMS, *Editor*

D. C. Transmission

SOME LIGHT has been directed on the issue of "transmission—a.c. or d.c.?" by papers at the recent Conference Internationale des Grande Reseaux Electriques a Haute Tension and by the just recently available German report of 1942 on the matter. The conclusions seem to conflict somewhat but allowances have to be made for the circumstances under which the analyses were made and the progress in technology in the interim between them.

Nevertheless, taking each on its face value the German report concludes that a.c. at 400 kv. is a better choice for delivering 2,000,000 kilowatts 375 miles away than 650-kv. d.c. overhead or 800-kv. d.c. cable would be. The margin is such that distance would have to be very considerably greater than 375 miles to dilute the terminal costs to a point of parity for a.c. and d.c.

On the other hand Ehrensperger of Brown Boveri at the Paris sessions estimated that d.c. transmission should cost substantially less than a.c. even if distance is as comparatively short as 250 miles and power transmitted is only 400,000 kilowatts. This contradicts the Germans, who found that equality in cost would come only in the greater power transmitted over far greater distance.

Thus, the answer in terms of dollars remains to be obtained. Technically, the Europeans, one group under stress of war and the other imbued by such vistas as prospective peace inspires, tacitly assume that transformers and circuit breakers can readily be extended to the a.c. voltages contemplated. About cables for 400 kv. to ground (800-kv. system) they are almost as confident, but about rectifiers and inverters they are more hopeful than confident.

Here in this country we have arrived at a decision which, for the time being, is likely to dampen what ardor there has been for d.c. transmission. One of the most promising areas where power availability and distances were both large was the Columbia River basin. It offered the incentive for some of the most recent studies. But the BPA engineers have now concluded that series capacitors can help 220 kv. do a 500-mile transmission job without recourse to d.c. or little else that is unconventional except accelerated tripping and reclosure. With this prime opportunity tacitly removed, as told by Chief Engineer Schultz in this issue, d.c. transmission will presumably have to await a new chance to demonstrate the superiority of the merits attributed to it.

Intimations of Future Good Times

THOSE viewers with alarm who want to keep unimpaired their pessimism about the industrial future of this country had better avoid all contact with the new business departments of electric utilities. If they do not, they may lose their cherished melancholy and find their faces wrinkling in the unaccustomed creases of a smile.

Particularly these Jeremiahs should keep their distance from power companies like the one with the longest corporate name, the one in Baltimore, Md. This company reports that service contracts for new industrial and commercial load totaled 49,800 kw. in 1945. But wait, 1946 is even better. In the first five months of this year over 23,800 kw. in new connected load was contracted for. The company names between 50 and 60 firms contributing to the 1946 load increase. About 20 percent of the installations, but only about 10 percent of the new load, are in the commercial class.

We have no such definite information as this from other utilities, but from general impression of new business activities, especially from reports of increases in power sales personnel, it seems that the situation in Baltimore is closer to being typical than exceptional. These evidences of the willingness of business to move ahead under the heterogenous and changing restrictions and hindrances of the confusing present augur well for the country's prosperity when conditions take solid shape and the revised rules of the game become clear.

Another State Adopts the N.E.S.C.

OHIO'S PUBLIC UTILITY Commission has revised its Administrative Order governing utility crossings and will henceforth apply the fifth edition of the National Electrical Safety Code.

The alternative course would have been a point by point discussion of provisions of Administrative Order 72 which have been in effect since 1921. The committee representing railroad, communication and electric utilities weighed numerous proposals to amend individual sections of N.E.S.C. for adoption in Ohio, but none were included in the final recommendation to the Commission.

Nationwide representatives have thoroughly considered a great mass of data and arrived at a reasonable and acceptable basis of agreement on the details in the N.E.S.C. It would seem superfluous for other groups in each state to

go through the same data and calculations to arrive at slight variations and modifications for a succession of individual state codes.

With many such individual state codes or rules, interests operating across state lines or in several states would face a variety of conflicting requirements. It would be difficult to form or maintain engineering, material or construction standards in the face of such confusion. Further, it is not possible to see how the divergences would be justified if each were based on sound engineering and safe practices. That is why the Ohio commissioners are to be commended for their consideration and their action in adopting the code provisions.

One suggestion may be in order for the N.E.S.C. committees which prepared the present edition. A functional index would save much difficulty in locating code sections applicable to various situations. The inadequacy of the present index was a serious objection advanced to adoption in Ohio. Someone should undertake preparation of a good index and make it available for publication. Every user of the N.E.S.C. would thank him.

Simplicity in the Philosophy of Relaying

IT is amazing what can be done in the electrical and mechanical control field with relays. Alarm bells can be rung and power plants can be started, switches can be opened and reclosed in cycles or minutes, and almost every conceivable trouble can be provided for and guarded against. Yes, even some things that have never happened can be anticipated.

Nevertheless, it is refreshing to hear a relay expert warn against too much relaying. Annunciators, bells and flags have their place, but the prime purpose of protective relaying is to maintain service to customers. On this basis, protection is applied primarily for the majority of faults. Elimination of complicated schemes for less important faults results in systems that are more easily designed and maintained. Modern line design, load control and system planning make some precautions actually superfluous if not added hazards.

Analysis of operating records and coordinated studies among transmission and distribution engineers and operating and relay engineers should be the starting point for new protection layouts. Each group is anxious to do a top-notch job in its own specialty and it may easily happen that troubles are created rather than prevented if there is not the fullest possible coordination between station and line designs.

One A.I.E.E. paper at the recent annual convention suggesting simplification of relaying came from eastern Canada and another came from southern California. They were far apart geographically but close together in their philosophy. It is safe to say that there are a lot of relays that would be eliminated if the principles suggested were followed.

Opportunity for Economy

WITH President Truman's letters to federal departments requesting reductions in spending, followed on by Reconversion Director Steelman's order holding up the letting of new contracts until October 1, and by the Budget Bureau's ceiling on construction outlays, maybe there is a chance that the government will not turn down an opportunity to save around $7,500,000. Small change, of course, in these days of appropriations of hundreds of millions, but "many a mickle makes a muckle."

A dam—Bull Shoals, it is called—is being built by the Army Engineers on the White River in Arkansas. The Arkansas Power & Light Co. wants to construct and operate a generating station at this dam and has applied to the Federal Power Commission for authority to do so. By giving the company this authority, the government will avoid putting public money into the generating station and the President's injunction to economy will be obeyed.

Bull Shoals is one of the 30 or so projects in the plans for a wideflung government power empire put forward by the Southwestern Power Administration. Undoubtedly any attempt to economize which requires reduction in these plans will be vigorously fought. So also, will attempts to economize in any direction. Always there will arise stout defenders of any plans, purposes, projects or policies that may be menaced by the cold hand of the money saver.

In the end, that is if the end actually is reduction of government spending, there will have to come a realization that, to paraphrase Salmon P. Chase, the way to economy is to economize. Many amiable and high sounding intentions, even some worthy purposes, will have to be given up when Uncle Sam takes off his Santa Claus suit, if he does.

Surplus and Shortage

AMONG those present when the Navy's power train was hooked into the system of the Salt River Valley Water Users Association, there must have been some whose memories went back 13 years to the time when the generators at Horse Mesa plant were loaded by means of a water rheostat in the tailrace. Water was urgently needed for irrigation and the only way to get it out of the reservoir was through the water wheels. Load on the electricity system was down and could not absorb the energy generated. So it was dumped into the river, some 50 to 60 million kilowatt-hours, at a guess.

Ironically, the power that was surplus in 1933, around 10,000 kilowatts, is about the same as the capacity of the power train that, at a rent of $100 per day, is meeting the present shortage. Seems as though one would be justified in lugging the phrase "poetic justice" into the situation.

In these conditions of surplus and shortage 13 years apart appears support for the arguments of those who see deficiencies in the multi-purpose dam concept on which is based practically the whole philosophy of government water power development.

WASHINGTON COMMENT

By R. N. LARKIN Washington Correspondent

Congress Changes Complexion

WHATEVER happens between now and November's general elections, sufficient change in the complexion of Congress already has transpired to warrant considerable attention from the electric power industry.

Two factors command this reappraisal, even with many primaries still to be held and with the outcome of the general election as uncertain as Washington insists that it is. These factors are the substantial casualties, through retirement and defeat, in that portion of Congress' membership which concerned itself actively with electric power legislation, and the approval of the Congressional reorganization bill.

Early in August, retirement or defeat had claimed 58 members of Congress. This figure will mount appreciably. What makes it so impressive is the identity of some of the losses.

Power Issue Secondary

In only one instance is there much indication that any power issue played much of a part. Only in the defeat of Sen. Burton K. Wheeler, Montana Democrat and a co-author of the Public Utility Act, does there seem to have been much emphasis on power. Wheeler, who had never been more than lukewarm about the Missouri Valley Authority which his fellow Montanan, Sen. James E. Murray, sponsored so unyieldingly, lost his primary race to Leif Erickson, whose devotion to MVA has been second only to Murray's. Thus, power was second to MVA as an issue, and MVA itself may have been less consequential than Wheeler's record of isolationism.

Sen. Henrik Shipstead, Minnesota Republican who was actively pro-public ownership and militantly pro-REA, lost renomination on the isolationism issue. Rep. Jed Johnson, Oklahoma Democrat and chairman of the Interior Appropriations subcommittee, lost a primary run-off. By no stretch of the imagination a private power man, nevertheless Johnson did more in recent years to curtail the expansionist power programs of the Interior Department than any other man who comes quickly to mind.

Rep. Lyle Boren, another Oklahoma Democrat, also lost a run-off. While he failed to win any of the major victories he sought for private ownership, including revision of the Public Utility Act, abrogation of REA's right to acquire existing systems, and removal of the tax inequity between public and private power operations, he was a member who would not only sponsor but would work actively for measures sought by private ownership, and this in the days when it was extremely difficult for private power legislation to obtain so little as a sponsor.

One House retirement which may result in a Senate addition is that of Henry C. Dworshak, Idaho Republican, who cooperated with Johnson in swinging the axe on Interior appropriations. Dworshak tended to resist Interior power activities as opposed to Interior Reclamation activities. More precisely, he was much more opposed to Interior's power marketing and transmission than to its power generation. He won the Republican nomination for U. S. Senator.

A Notable Loss

Another notable loss is that of Rep. Malcolm C. Tarver, Georgia Democrat, who headed the Agriculture Appropriations subcommittee. Tarver held down rural electrification loan funds in the days when materials were scarce, to the anguish of Rural Electrification Administration die-hards. Yet he pushed through in 1945–46 more funds than REA had been given in the previous decade. His defeat will not imperil future REA loan funds.

Three men less actively concerned with power legislation but 100-per-centers for public ownership when the problem arose, also met primary defeat. They are Reps. LaFollette, Indiana Republican, Patterson, California, and Patrick, Alabama, both Democrats. A fourth loser was Rep. Thomas Winter, Kansas Republican, who tended, during hearings on revision of the Public Utility Act, to find some merit in the views of industry witnesses.

In the Senate, casualties include several men not leaders in power legislation, but who left records indicating their positions thereon. Included are Democrats Swift, Alabama, Andrews, Florida, and Gossett, Idaho, who voted for the two Hayden amendments to the 1947 Interior Appropriations bill restoring funds for Central Valley transmission lines and for the Southwestern Power Administration, and Mead, New York Democrat who favored both Hayden amendments and voted against the industry-supported "Bailey amendment" to the 1944 Flood Control Act.

Other Senate Losses

On the other side of the fence, Senate losses include Radcliffe, Maryland, and Gerry, Rhode Island, and Republicans Hart, Connecticut, and Willis, Indiana, who supported the Bailey amendment, and Austin, Vermont Republican who supported the Bailey amendment and opposed the Hayden amendments.

In the House, where record votes are fewer and easier to dodge, it is well nigh impossible to classify at all accurately with regard to the public-private power ownership issue many of the remaining casualties. Judging the 37 House casualties not already mentioned on the most general standards, and indicating probabilities rather than certainties, it might be said that 13 of them tended to support public ownership and 12 of them private ownership. The remaining dozen either could not be judged at all or could not be counted upon to support either side. The other two Senators could not be classified.

Several public ownership stalwarts won renomination to the House. They include Democrats John Rankin, Mississippi, and Hugh DeLacy and Charles Savage, both of Washington. Oren Harris, Arkansas Democrat who sponsored legislation bitterly opposed by REA, won an election reportedly narrowed by co-op opposition to him.

NEWS OF THE WEEK

Utilities May Be Seeking Control of Army Dam Power

Following Application to FPC by Arkansas Power & Light to Build Plant at Army's Bull Shoals Dam, Georgia Power Is Reported Asking Same Right at Clark Hill Dam

POSSIBILITY that the privately owned electric power industry may be renewing its earlier bids to control all marketable energy generated at War Department dams was seen this week in the wake of an application by Arkansas Power & Light Co. to the Federal Power Commission for a license to build a hydroelectric plant at the Army Engineers' Bull Shoals Dam on Arkansas' White River.

The possibility was bolstered by a report that Georgia Power Co. is planning a similar application for a license to construct a hydro plant at the Army's Clark Hill Dam on the Savannah River about 20 miles upstream from Augusta, Ga. No such application had been filed with FPC early this week.

War Department attaches said that no decision had been reached by the Corps of Engineers' Civil Works Division against building the hydroelectric stations which have been authorized and appropriated for at both Bull Shoals and Clark Hill. On this basis, the consensus was that the A. P. & L. application and any similar application which might be filed by Georgia Power would be largely academic, more for the purpose of establishing a record than in actual expectation of winning any such license.

As far as could be determined, there was no concerted action by the Georgia and Arkansas companies. Utility officials in the Pacific Coast region asserted that they had no knowledge of the Arkansas and reported Georgia applications. They added that they planned no similar applications with respect to Army dams authorized and appropriated for in that area.

The electric utility industry generally and Southwestern companies in particular have been interested for years in obtaining Army-generated energy at the damsite for distribution through existing systems. If private utilities were to construct the power stations at War Department flood control and rivers and harbors dams, such an end essentially would be achieved. Thus, the A. P. & L. application, coming as it does in the absence of any Army determination against building the power plants, is widely considered as an attempt to determine whether this can be done.

The problem arose first in any real sense when Congress was considering the Flood Control Act of 1944. Army generation previous thereto was limited. Bonneville and Fort Peck dams in the Northwest and a small dam on the St. Mary's River in northern Michigan were about the only Army-controlled producers. Bonneville output was sold by the Bonneville Power Administration, Fort Peck energy was marketed by the Reclamation Bureau under an executive order, and the limited St. Mary's output was sold to the Edison Sault Electric Co., Denison and Norfolk Dams, in Texas and Arkansas respectively, had not yet started generation, nor had Dale Hollow, Center Hill and Wolf Creek Dams on the Cumberland River and its tributaries.

As the Flood Control Act of 1944, which authorized a substantial number of power projects, began its legislative journey in the House, an attempt to insert into it a provision requiring that Army-generated energy be marketed by the Interior Department was defeated. In the Senate, a further attempt was made to write this into the bill. The first fight, however, arose over an amendment by Sen. Josiah Bailey, North Carolina Democrat, which would have had the effect of giving private utilities an excellent chance to buy all Army-generated energy at the busbar. This was defeated decisively after prolonged debate. In its place was adopted what is now section 5 of the Flood Control Act of 1944, whereunder the Interior Department is given marketing jurisdiction over all salable Army-generated energy.

The next attempt to control Army-generated energy was made last winter when the twelve members of the Southwest Power Pool offered to buy all energy generated at War Department dams in their territories. This was rejected by the Interior Department through its Southwestern Power Administration.

The A. P. & L. license application is widely regarded as a third move in the same direction. The report of the Georgia Power application seemed to confirm this.

A. P. & L. is not without long-standing interest in the power development of the White River. Early in the last decade it organized a wholly owned subsidiary, the White River Power Co., which had applied for an FPC license to develop power at the Wildcat Shoals site, immediately downstream from the Army's Bull Shoals Dam. Such a license was granted in 1936, Federal Power Commission sources disclosed, but rescinded two years later. Nothing was done in the interim to construct the project which suffered from the effects of the depression as did many similar utility hydro proposals.

License Would Set No Precedent

There is ample precedent for the granting by FPC of a license for the development by private interests of hydroelectric energy at federal water control projects. A number of such licenses have been granted; but because of substantial changes both in membership and thinking by the Federal Power Commission since the days when these licenses were granted, it is agreed that the likelihood of similar license grants today has decreased considerably.

It was pointed out further that, since some of these licenses were granted, the United States has adopted new and much more vigorous policies regarding water control and use. Adding these factors to the fact that at Bull Shoals and numerous other power dams, Congress has not only authorized hydro stations but also has appropriated funds for their construction by the Army, observers predict that any industry move to make similar applications at all authorized War Department dams would have to travel a rocky road.

It was regarded as certain that loud protests would be made by the Interior

Department against the acceptance of any such policy by FPC and the War Department.

In some circles, it was pointed out that if the Arkansas application and that reported under preparation by Georgia Power were in fact "trial balloons" for a new policy, they could hardly be launched at a more propitious time. These observers noted the recent economy drive by President Truman, which has been aimed thus far primarily at federal construction, and pointed out the federal expenditures could be saved if private utilities were to make all power investment at authorized water control projects. Whether or not the possibility of substantial savings would outweigh Mr. Truman's avowed support of public ownership, however, was conceded to be another matter entirely. On his record, there is scant reason to believe that Mr. Truman wants a balanced budget more than continued growth of public ownership of electric power facilities.

At almost none of the Army dams for which funds have been appropriated is there much possibility that the existing construction downhold would interfere with or motivate private company desires to construct hydro plants. As announced last week, the downhold extends through fiscal 1948, or June 30, 1948. A.P.& L.'s. application stipulates that work on the Bull Shoals powerhouse would be started July 1, 1948, or 30 days after granting the license, whichever is later.

Furthermore, virtually all of the unconstructed dams for which appropriations have been granted are about two years away from the date at which powerhouse construction would have to start to begin generation as soon as possible.

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Memphis Extends Line

Memphis Light, Gas & Water Commission will spend $73,844 to extend its 100-kv. transmission lines from city limits to the plant of the International Harvester Co. now under construction at the mouth of the Loosahatchie River. The line will be a part of a future high-power belt around the outlying suburbs.

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Utility Expanding Plant

Public Service Co. of Colorado is doing the preliminary engineering work for the expansion of its 5,750-kw. Alamosa steam plant. A 5,000-kw. turbine, a boiler, cooling towers, condensers, and auxiliary equipment will be added. The $530,000 project is to be completed in the summer of 1947.

Destruction from Atomic Bomb Continues after Explosion in Form of Radioactivity

Philip Swain, McGraw-Hill Representative at Operation Crossroads, Explains Value of Tests in Peace and War —Points Out Scientific Gain of $70,000,000 Experiments

DESTRUCTIVE FORCE sufficient to sink 40 warships if bunched solidly rail to rail is the capability of a single atomic bomb in the opinion of Philip W. Swain, editor of *Power*, expressed in an interview with ELECTRICAL WORLD upon his return to San Francisco from Operation Crossroads. Swain was McGraw-Hill's official representative at the Bikini tests and was the first of three McGraw-Hill editors who were there to arrive back on the West Coast.

Actually, he said, only a few ships were sunk in underwater test Baker because they were purposely widely dispersed. Tests were not conducted to find out how many ships an atom bomb could sink, but rather to determine what happens at various distances from the bomb explosion. The $70,000,000 spent on Crossroads was for the purpose of locating points on a series of curves relating distance from the bomb explosion to effect on ships, equipment, supplies and crew—also relating distance to such basic effects as pressure, flash intensity, and radiation. These curves, private property of the Navy, will be essential to the design and operation of an effective Navy in an atomic age.

Swain's observation of the results of the air burst indicates that it sinks ships up to one-eighth mile, does severe damage to one-quarter mile, moderate damage to one-half mile, slight damage to three-fourths mile, and trivial damage up to a mile. Beyond half a mile, damage is confined mainly to superstructure, he said. Beyond half a mile many crew members, if suitably protected, might survive blast and flash, only to die later from radioactivity.

Radioactivity, says Swain, must still be a question mark in the public mind because Crossroads has not revealed, and probably will not, which animals died on which ships and when. It may be found that with an air burst, radioactivity can put ships' crews out of action three-quarters of a mile away.

Discussing the underwater burst, he said that it sinks ships 1,500 ft. and possibly 2,000 ft. or more away. However, ships beyond half a mile now seem less damaged by shallow underwater bursts than the air burst. Nevertheless, he said that the radioactive peril to crews from the underwater burst is extraordinarily high because fission products trapped in the water spout are showered over the ships so that they become unlivable for days.

For example, probably less than one ounce of sticky fission products was deposited on the decks and superstructure of the Jap battleship *Nagato*, yet three days after the blast, this ship was so "hot" that a man standing on her deck for one day would have received radioactivity equivalent to 1,000 chest X-rays, or 1,000 times the safe permissible dose. Incredibly powerful radioactive poisons on and in ships and in the water beneath them after underwater burst might put ships out of action over several square miles.

Summing up, Swain agreed that congested cities and industrial areas are the ideal atom bomb targets, noting, however, that a single atomic bomb can always sink one ship (more if they are close) and that a big ship will cost more than an atomic bomb.

While these tests were conducted expressly for the purpose of determining the effect of atomic bombs against ships, much knowledge of peace-time value will result. For example, the observed effects of radioactivity on experimental animals and of subsequent treatment for their survival will help the electric utilities to plan necessary safety measures for atomic power plants.

When the atomic power age is here the Geiger counter, so effectively used to protect Crossroads personnel, may become as common as ammeters or voltmeters. The one thing possibly of the greatest peace-time value that came out of Bikini, said Swain, is full confirmation of what we already knew—that radioactivity resulting from atomic fission is unbelievably powerful and destructive. This again emphasizes one of the main problems in atomic power plants—that of the terrific amount of shielding (50 tons or more) that will be required to protect workers from these lethal rays.

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Consulting Firm Formed

Thomas S. Burns, formerly with the U. S. Engineer Office, Providence, R. I., and Col. Waldo I. Kenerson of Marblehead, Mass., have formed the consulting firm of Burns & Kenerson, Inc., 20 Kilby St., Boston, Mass. Their practice will include valuations, hydroelectric development, and other fields of civil and mechanical engineering activity.

Government Agencies Study Construction Curtailment

Compliance with Presidential Order for Economy Leads TVA to Review Plans—Work on Watauga Dam Likely to Continue —Co-ops Express Disapproval of Any Move to Halt Loans

PRESIDENT Truman's orders that federal construction spending be reduced by $700,000,000 in the present fiscal year has caused the Tennessee Valley Authority to review its construction program at Watauga dam, but it is not believed likely that work on the $28,600,000 project will be halted.

Current TVA construction activity is limited to Watauga, although some preconstruction work such as land acquisition and planning for road relocation is going on in connection with South Holston Dam. These two dams were started about December 7, 1941, but were halted by War Production Board order the following fall. It had been planned to resume active construction on South Holston next year.

Principal reason why Watauga is not expected to be halted again is the fact that construction thereon had been resumed well in advance of the President's directive that expenses be cut. In addition, Watauga is a rock and earth-fill dam, which would offer little competition to the Veterans' Housing Program. All equipment and housing have been at the site some time, and a second work stoppage would probably increase costs more than it would be worth now.

Asks Reduction in Expenditures

Mr. Truman also asked that TVA reexamine its "Program of Resources Development" with a view to accomplishing a substantial reduction in expenditures for fiscal 1947.

In letters to other construction agencies, Mr. Truman made similar requests for economy. After establishing $85,000,000 as the new construction ceiling for the Reclamation Bureau in fiscal 1947 and 1948, Mr. Truman notified Interior Secretary J. A. Krug that:

"These reduced expenditure levels for the Bureau of Reclamation should be kept in mind as a guide when reviewing the construction expenditures of the National Park Service, Office of Indian Affairs, Bonneville Power Administration, and the Southwestern Power Administration."

REA officials, meanwhile, are seeking methods of making what savings they can in their loan program, which Mr. Truman exempted from specific curtailment with the comment:

"I recognize that in the case of the loan program of REA, direct federal action is not possible. The program and project determination are in the various REA cooperatives, and other local groups. However, in view of the importance of curtailing federal expenditures to decrease inflationary pressures, and in view of the magnitude of the federal financial participation in the REA program, it is important that expenditures for this program also be held to a minimum.

"Therefore, I am asking you, Agriculture Secretary Anderson, to take up this matter with the cooperatives and local groups and urge them to keep expenditures for construction to a minimum consistent with the curtailed activities in other federal public works during the fiscal year 1947. The most effective assistance would be obtained if the local groups would voluntarily follow the spirit of the directive issued by the Office of War Mobilization and Reconversion during fiscal year 1947."

His OWMR reference was to the accompanying directives of OWMR Director John Steelman, halting all contract letting until October 1 and providing only for a minimum of new construction thereafter.

Contract Awards Halted

Principal concern of REA backers seems to be the possibility that the Steelman directive might be construed as holding up all loans by REA to cooperatives until October 1, the date before which no new federal construction contracts may be let. Just why this possibility was regarded seriously is not immediately clear, particularly in view of the fact that relatively little of the money advanced between now and October 1 is likely to be spent by that time. However, attempts are actively in progress to insure that the Steelman directive be not so construed.

Avery Moore, of The National Rural Electric Cooperative Association, said a poll of NRECA members had showed, in early returns, an overwhelming insistence by co-op leaders that construction loans flow ahead as usual.

In setting ceilings on the civil works construction of the Army Engineers for fiscal 1947 and 1948, Mr. Truman not only limited the over-all construction budgets but also limited even more severely the amount of new river and harbor construction which can be done.

Army flood control construction was limited to $95,000,000 for fiscal 1947 and $110,000,000 for fiscal 1948. Its river and harbor construction was limited to $90,000,000 for fiscal 1947 and $95,000,000 for fiscal 1948. In each year, new construction is not to exceed $25,000,000 yearly. This will probably result in the deferment for both fiscal years of any new power projects authorized and appropriated for under the rivers and harbors program, since many more navigation than power projects could be performed under a $25,000,000 limitation on new work.

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I. B. E. W. Seeking Contracts with 3 Nebraska P. P. D.'s

The International Brotherhood of Electrical Workers, A.F.L., will seek a contract with Nebraska's three hydroelectric public power districts. Robert Garrity, union representative, made this statement following a refusal of the Platte Valley, Loup River, and Tri-County Districts to negotiate with the union claiming that they are owned and operated by the public and "therefore cannot enter into any contract by which contracts are accorded any group."

Garrity replied that the refusal of the districts to deal with the union is "enough to make the public understand that they are claiming a special privilege for themselves. Their refusal means that they are indulging in a subterfuge." He also pointed out that the government which created these projects gives the employees the right to organize and bargain collectively, promised to fight to win this right and to appeal to the federal government for a "fair settlement."

The unions in 1944 called a state-wide strike but were unsuccessful. The districts said that last March the workers were given a "substantial increase." The districts provide power for virtually the entire state except the eastern section served by the Nebraska Power Co.

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P. S. C. Sets Original Cost

The original cost of property of the old Buffalo Niagara Electric Corp., one of the constituent companies of the recently consolidated company of the same name, has been determined as $88,816,777 by the New York Public Service Commission. This is a reduction of more than $1,497,000 from the company's book figures of $90,313,838, as of January 1, 1939.

Westinghouse Will Aid Chinese Develop $35,000,000 Electrical Manufacturing Plant

American Firm Will Design Plant, Specify Machinery, Train Personnel, and Provide Production Processes—20-Year Pact Gives Government of China Complete Ownership and Control

PLANS of the Chinese government to build a $35,000,000 electrical manufacturing plant to be designed and equipped by American engineers, for the manufacture of central-station and other electrical equipment under American patents, were revealed by William E. Knox, president, Westinghouse Electric International Co., in New York last week.

Under a 20-year agreement with the National Resources Commission of China, Westinghouse will design the proposed plant, provide production processes, specify machinery, and train personnel. The contract is one of 15 or 20 "technical assistance contracts" under which the Chinese Commission hopes to import American industrial "know-how" and processes into China.

Westinghouse, according to Knox, will have no financial interest in the Chinese project, which is somewhat similar to an earlier agreement with Mexican interests. Under the agreement, Westinghouse will receive a lump sum payment, for patents and technical services, during the first ten years of the plant's operation and royalty payments during the second ten years. The plant, he continued, will manufacture generators, transformers, meters and relays, and will employ 3,800 persons. It will be equipped with machine tools costing about $15,000,000.

Participation of the company in China's industrialization program, according to Knox, is based on the conviction that "you can't do business with a poorhouse." If America wants to sell to the world, it must help the world to help itself industrially.

American "Know-How" in Demand

"This country has three major commodities it can export," Knox continued. "We can sell the world consumer goods and other products of our technological superiority, we can sell material wealth —raw materials—and we can sell brains. It's the last of these that is in greatest supply and in greatest world demand.

"Merely making American patents available abroad is meaningless. What the rest of the world wants from us is our production processes—our 'know-how'," he asserted.

Knox warned that America's booming foreign trade will maintain its present record pace for at least the next three or five years after which it will recede rapidly to pre-war proportions. The "sellers' market" in world trade will end quickly, he predicted, when industrial nations ruined by the war get back into production stride. Britain, he noted, is already regaining her place in world markets.

Illustrating the booming levels of present foreign demands, Knox disclosed that his company has a present backlog of foreign orders "just a little under $60,000,000," exclusive of appliances such as refrigerators. Approximately 15 percent of Westinghouse output is going into foreign trade today, he revealed.

American mass-produced consumer items—automobiles, refrigerators and the like—will again lead our foreign trade as they did before the war because they are better and lower in cost. Labor cost in such items is a small part of the total cost, in spite of the fact that American real wages lead the world.

This favorable labor-cost relationship will not apply to American capital goods once industrial plants of competitor nations are rebuilt, Knox pointed out. In producing such goods our high wages and high standard of living work to our disadvantage in world competition, he explained. For example, in normal times turbine-generators are not a practical commodity for American foreign trade, for this reason, Knox asserted. Before the war British turbine-generators could be sold to the world at American factory cost for a profit. Germany could sell generators profitably at British factory costs, and Japan could make a profit on turbine-generators sold at the Germany factory cost.

This condition prevailed in 1938 and will prevail again, with most of our non-consumer goods, Knox said.

However, America will continue to find a ready market for heavy industrial specialties such as large waterwheel generators, high-voltage power transmission equipment, and highly specialized production tools. Few other countries have had experience building large waterwheel generators. Because the investment in hydroelectric plants is so large and there is so much to be lost from faulty design, the United States is likely to retain its world market for such equipment indefinitely, Knox asserted.

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Duke Power Seeks System

Duke Power Co. has bid $34,877.86 for title to the electric distribution system at Morris Field, a former Army air field now the property of Charlotte, N. C., which will expand its limits to take in the community with its 15,000 residents.

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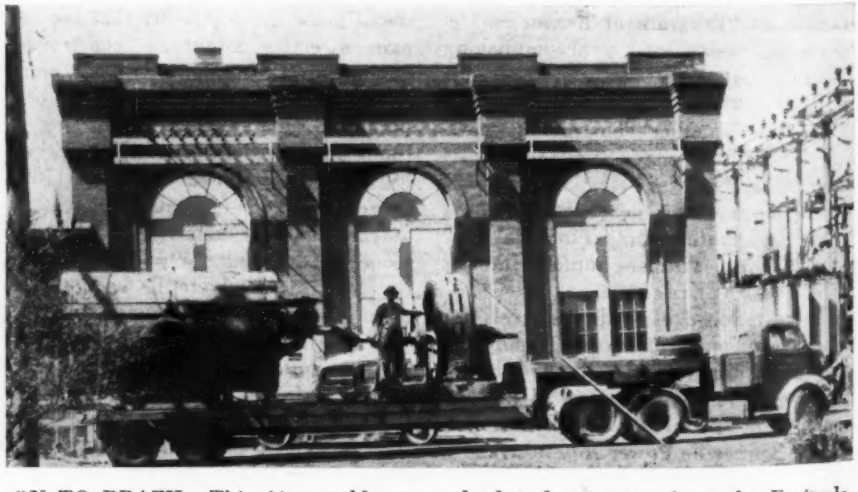
Iowa Franchises Granted

Iowa Public Service Co. recently secured a 15-year franchise in Storm Lake by a vote of 1,361 to 92 and a 20-year franchise in Alton by a vote of 192 to 26.



ON TO BRAZIL—This 44-year-old water wheel and generator from the Fruitvale, Wash., plant of Pacific Power & Light Co., is on its way to Vancouver, B. C., where it will be reconditioned preparatory to shipment to Brazil where it will be used in the production of food under the UNRRA program. The 350-kw. unit had been idle for 17 years. On the truck is Lou Happy, one of the operators when the unit was first installed

Southwest Power Pool Members Continue Opposition to SPA Rate Schedules

Utility Companies Call 2 Schedules Filed with FPC by Administrator Douglas Wright Discriminatory and Unjust—REA Co-ops and Municipalities Are Favored

MEMBER COMPANIES of the Southwest Power Pool, it was indicated this week, probably will not withdraw their opposition to rate schedules filed with the Federal Power Commission by the Southwestern Power Administration. This appeared likely even though SPA Administrator Douglas G. Wright has held up one of the two schedules submitted because of his failure to obtain appropriations for steam-electric generating plants.

One of the twelve member companies had notified FPC early this week that it would not withdraw its opposition despite Wright's request that FPC "hold in abeyance" one of the two schedules he had submitted. It was expected, on this basis, that other companies would answer similarly.

Pool members protested the schedules some time ago on the basis that they are unjust and discriminatory. Wright first rephrased the schedules slightly, then asked that one, which he described as dependent upon the availability of steam-electric firming capacity for SPA's hydro output, be "held in abeyance" until such firm energy became available. He indicated that this might be done through purchase, interchange agreement, or by the erection of SPA-owned steam-electric capacity. The last possibility, Wright told FPC in his letter, would require specific authorization from Congress, to be followed by appropriations; either of the two former possibilities, he added, might result from "negotiations which we propose to undertake with existing systems in the near future."

Two Rate Schedules Proposed

Wright had proposed two rate schedules, A and B, both of which differed almost completely from those originally proposed by SPA in its comprehensive report.

Schedule A, which is to be applicable to "any customer purchasing power in wholesale quantities for firm power service who contracts with the administrator for a specified number of kilowatts," calls for a demand charge of $1.35 per month per kilowatt of billing demand and an energy charge of 4 mills per kilowatt-hour for all energy in excess of 200 kw.-hr. a month. Schedule A was described by Wright as "primarily a peaking rate and . . . designated to encourage use of this type of power by privately owned utility companies, having their own generation, which could use it at low load factors."

Schedule B, which is to be applicable to "any customer purchasing power in wholesale quantities for firm power service who contracts with the administrator for a specified number of kilowatts and who purchases 75 percent or more of its entire power requirements from the administrator," calls for a monthly demand charge of $1.75 per kilowatt of billing demand, and an energy charge of 1.75 mills per kilowatt-hour for all energy in excess of 300 kw.-hr. a month.

Schedule B, which is the rate Wright has asked be "held in abeyance," was described by him as "designed to encourage maximum power utilization by rural electrification administration cooperatives and municipalities, which are expected to purchase at least 75 percent of their power requirement from SPA, and will encourage the location of new industries in the area."

Power pool members listed numerous reasons why they consider the rates unjust and discriminatory, but outstanding in their protest was their contention that they could only qualify for the cheaper rates of Schedule B by taking at least 75 percent of their requirements from SPA. They added that SPA obviously could not begin to furnish them this much energy or capacity.

In his letter asking that FPC approval of Schedule B be held up until provision can be made for steam back-up for his three-dam hydro system, Wright confirmed earlier predictions that he would seek legislation specifically authorizing SPA to construct its own fuel plants.

"In view of the feeling of the Congress that there is a question as to our authority to construct fuel-burning generation under the Flood Control Act of December 22, 1944," Wright wrote FPC, "it is our intention to recommend to the Department of the Interior that appropriate legislation be suggested to the Congress specifically authorizing such construction".

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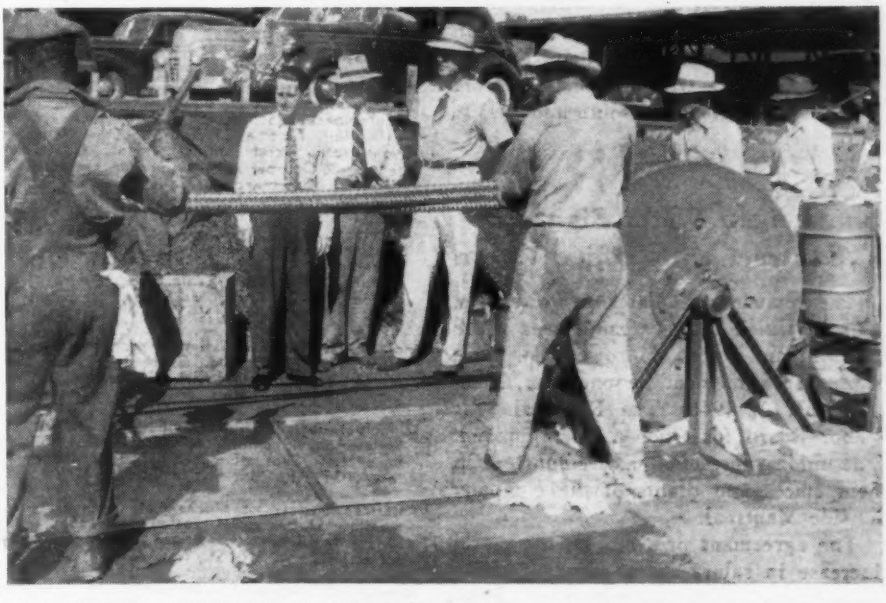
Bagnell Dam Hearings Set

The Federal Power Commission will hold hearings October 14, at Jefferson City, Mo., regarding the effect of the Union Electric Co.'s Bagnell Dam on Osage River floods.

The hearings follow submission by Union Electric months ago of a report on its operation of the dam. The report showed that the dam and its operation in no way augmented Osage River floods and may have lowered them. Property owners below the dam, according to



INSTALLING OILOSTATIC CABLE—Unreeling and cutting lead covering from a 1,350-ft. length of 110-kv. oilostatic cable being installed by Georgia Power Co. in Atlanta between the Grady and Boulevard substations, a distance of five miles. P. B. Boyd, left, distribution engineer; H. W. Cauthen, underground engineer of Atlanta Division, and R. D. Fox, right, superintendent of underground, watch

FPC, have urged that Union Electric be compelled so to operate the property as to cut down flood crests or at least not to increase them. FPC ordered the report submitted almost two years ago.

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Nebraska Public Power System to Spend $4,209,800

A $4,209,800 expansion of the Nebraska Public Power System will be carried out in the next three years, George E. Johnson, chairman of the board of managers of the system and chief engineer and general manager of Central Nebraska Public Power and Irrigation District, has announced. Availability of materials and equipment will determine the rapidity of construction.

The program is divided into five parts and will be carried out by the Consumers P.P.D. and three hydro generating districts.

The parts and the amount to be paid by Consumers and by the hydro districts are:

Part	Consumers	Hydros
Norfolk	$161,000	$1,043,000
Belden-O'Neill	1,091,300	25,000
Beatrice	910,500	15,000
York	158,000	150,000
Superior	461,000	195,000
Total	$2,781,800	$1,428,000

The Norfolk part represents new service to Norfolk both from Columbus and from the main transmission line at Freemont by way of Oakland to Norfolk. The Belden and O'Neill part is an extension of the 115-kv. system to O'Neill from Norfolk and additional substation facilities at Belden. The Beatrice part is new service to Beatrice and surrounding territory. The York part is a new substation on the 115-kv. system at York. The Superior part is a transmission line from the Hastings substation south and east to Superior.

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Shawinigan Water Signs Contract with Office Union

The Shawinigan Water & Power Co. and the Union of Office Employees of the Shawinigan Water & Power Co. have signed an agreement for one year, effective July 1, 1946. The Regional War Labor Board for Quebec has approved. The union represents office employees in field offices and plants of the company outside Montreal.

The agreement provides for a general increase in salary rates, standardization of working hours, two weeks paid vacation, ten legal holidays with pay, and grievance and arbitration procedure. Provision is made for renewal or amendment of the contract at the expiration of the contract.

Colorado Co-ops Prepared to Spend $11,000,000 Fund

Colorado's electric cooperatives are on the march with a program to spend some $11,000,000 of REA money before the end of 1947 on construction of new distribution lines, and purchase or construction of generating plants.

Records at the Colorado Public Utilities Commission show that a cooperative in Rio Blanco County bought, and has been operating since June 15, the municipally owned power plant at Meeker, Colo., for which it paid $75,000; and that the same co-op is authorized to draw on REA for a maximum of $4,000,000 to develop its well crystallized plans for expansion of service.

According to O. E. Gregory, Greeley, Colo., president of the Colorado Association of REA Cooperatives, the various affiliate-members contemplate more than 10,000 miles of new lines, to reach 6,500 additional farms in the immediate future, with availability of materials the only discernible obstacle to completion on schedule.

William Hedges Robinson, attorney for the state organization of cooperatives, disclosed August 3 that two new cooperatives—at Walden and Allen's Park—have recently been admitted to the association; and that engineering preliminaries are now under way anticipating the construction of a $750,000 power generating plant in southeastern Colorado, to service Limon, Burlington, La Junta and other areas of that region. The plant, he said, will probably be fueled by natural gas. Because the exact site has not yet been determined, construction cost to the county cooperative which will build it is unassigned.

MEETINGS

American Institute of Electrical Engineers—Pacific Coast District, Olympic Hotel, Seattle, Wash., August 27-30; Great Lakes District, Claypool Hotel, Indianapolis, Ind., October 9-11. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

Pennsylvania Electric Association—Meter Committee, Benjamin Franklin Hotel, Philadelphia, Pa., November 7-8. R. A. Black, chairman, West Penn Power Co., Connellsville, Pa.

Previously Listed

Rocky Mountain Electrical League—Annual convention, Stanley Hotel, Estes Park, Colo., September 5-7. R. B. Hubbard, manager, Gas & Electric Bldg., Denver 2, Colo.

Instrument Society of America—National Instrumentation Conference and Exhibit, Wm. Penn Hotel, Pittsburgh, Pa., September 16-20. Richard Rimbach, executive secretary, 1117 Wolfendale St., Pittsburgh 12, Pa.

Illuminating Engineering Society—National convention, Chateau Frontenac, Quebec, September 18-21. A. D. Hinckley, executive secretary, 51 Madison Ave., New York 10, N. Y.

International Association of Electrical Inspectors—Northwestern Section, Boise Hotel, Boise, Idaho, September 23-25; W. L. Gaffney, secretary, 402 City Hall, Tacoma 2, Wash., Southwestern Section, Hotel Sacramento, Sacramento, Calif., September 30-October 2; H. L. Gerber, secretary, 205 City Hall, San Francisco, Calif. Southern Section, George Vanderbilt Hotel, Asheville, N. C., October 14-16; A. M. Miller, secretary, 910 W. 30th St., Richmond 24, Va. Western Section, Gibson Hotel, Cincinnati, Ohio, October 21-23; F. H. Moore, secretary, 320 N. Meridian St., Indianapolis 9, Ind. Eastern Section, Mark Twain Hotel, Elmira, N. Y., October 28-30; F. N. M. Squires, secretary, 85 John St., New York 7, N. Y.

Indiana Electric Association—French Lick Springs Hotel, French Lick, Ind., September 25-27. E. F. Hauser, secretary, 1414 Circle Tower, Indianapolis, Ind.

Municipal Electric Utilities Association of New York State—Annual conference, Mark Twain Hotel, Elmira, N. Y., September 25-27. T. J. McKee, secretary, 200-212 E. Third St., Jamestown, N. Y.

American Society of Mechanical Engineers—Fall meeting, Statler Hotel, Boston, Mass., September 30-October 2. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

International Association of Electrical Leagues—Annual conference, Astor Hotel, New York, N. Y., October 2-4. O. C. Small, secretary, 155 E. 44th St., New York 17, N. Y.

Southeastern Electric Exchange—Engineering and Operation Section, Henry Grady Hotel, Atlanta, Ga., October 3-4; Accounting Section, Fort Sumter Hotel, Charleston, S. C., October 17-18; Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., November 6-9. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 1, Ga.

National Electronic Conference—Second annual conference, Edgewater Beach Hotel, Chicago, Ill., October 3-5. E. H. Schulz, secretary, Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

Edison Electric Institute—Electrical equipment committee, New Ocean House, Swampscott, Mass., October 4-5; transmission and distribution committee, Cavalier Hotel, Virginia Beach, Va., October 7-8. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

National Electrical Contractors Association—Annual meeting, Ritz Carlton Hotel, Atlantic City, N. J., October 14-18. C. J. Harder, national secretary, 633 Investment Bldg., Washington 5, D. C.

Electrochemical Society—Fall meeting, Royal York Hotel, Toronto, Canada, October 16-19. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

Pennsylvania Electric Association—Electrical equipment committee, Lord Baltimore Hotel, Baltimore, Md., October 24-25; B. E. Hagy, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa. Transmission and distribution committee, Abraham Lincoln Hotel, Reading, Pa., October 24-25; C. C. Farrell, vice-chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa. Transmission and distribution committee, Abraham Lincoln Hotel, Reading, Pa., October 24-25; C. C. Farrell, vice-chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa. Systems operation committee, Skytop Lodge, Pa., November 7-8; A. R. Deck, chairman, Metropolitan Edison Co., Reading, Pa.

American Welding Society—Annual meeting, New York, N. Y., October 24, and Atlantic City, N. J., November 17-22. M. M. Kelly, secretary, 33 W. 39th St., New York 18, N. Y.

National Electrical Manufacturers Association—Annual meeting, Traymore Hotel, Atlantic City, N. J., October 28-November 1. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

National Farm Electrification Conference—Sherman Hotel, Chicago, Ill., November 7-8. G. W. Kable, chairman, *Electricity on the Farm*, 24 W. 40th St., New York 18, N. Y.

National Research Council—Conference on Electrical Insulation, Johns-Hopkins University, Baltimore, Md., November 7-9. W. F. Davidson, chairman, Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York, N. Y.

National Association of Railroad and Utilities Commissioners—Annual meeting, New Orleans, La., November 12-15. Ben Smart, secretary, 7411 New Post Office Bldg., Washington, D. C.

Toledo Edison Gives Results of Recent Farm Survey

The percentage of farms using electricity in northwestern Ohio is more than 30 percent above the national average, according to a survey made by Toledo Edison Co. in the eight counties served by its power grid.

In this area (Lucas, Wood, Fulton, Henry, Williams, Defiance, Ottawa and Sundusky counties) there are 10,840 farms served by the company, more than 86 percent of the total number to which Edison power is available, R. E. Johnson, head of the company's farm electrification department, reported. Nationally, the proportion of electrified farms is just above 50 percent.

During the last five years the use of electricity by farmers has nearly doubled, Mr. Johnson said. In 1941 each Edison farm customer was using an average of 1,109 kw.-hr. of electricity yearly, while in the year ending in May, 1946, the average had jumped to 2,033 kw.-hr., he stated. Because of this increased usage the farmer's rate-per-kilowatt-hour is only three-fourths as much as it was five years ago, he pointed out.

"Two factors were responsible largely for this increase," Mr. Johnson said. "First is the willingness of most farmers to follow the example of their neighbors in adopting new time and labor-saving electrical devices. Second is the assistance available from company farm power engineers in building and installing new farm electrical equipment. . ."

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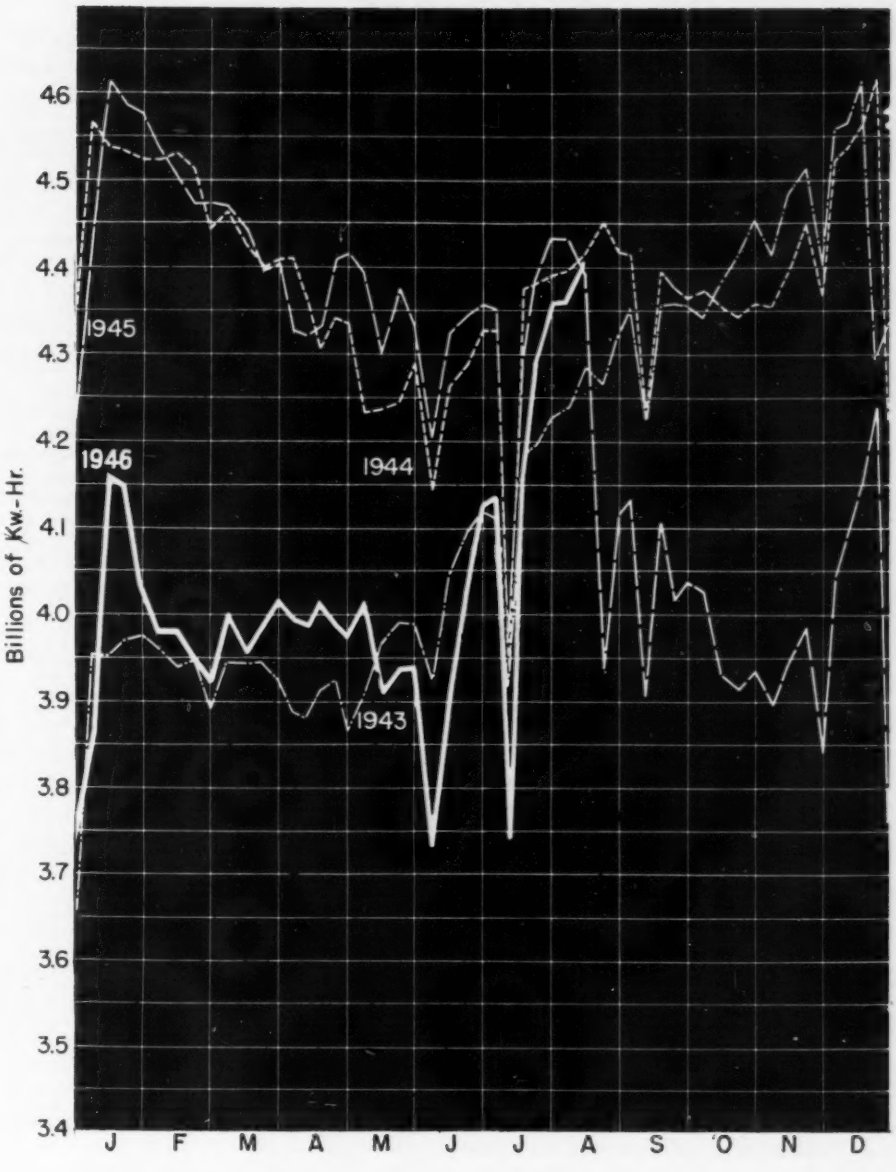
Pacific Gas & Electric Co. to Build $19,000,000 Plant

Pacific Gas & Electric Co. has announced it will spend $19,000,000 to enlarge the power generating capacity of "Station P" steam plant, San Francisco.

Norman R. Sutherland, manager of the company's San Francisco division, reported that two 100,500 hp. turbine-generators and auxiliary equipment will be added to the facilities of the plant, quadrupling its capacity to 263,000 hp. The expansion, expected to be completed in late 1948, will make the station the largest of P. G. & E.'s steam-operated power plants.

The new generating units will be installed in a $1,870,000 building to be constructed adjacent to existing Station P structures.

The units will operate at 3,600 rpm. with a pressure of 1,500 lb. at 900 deg. F. Steam will be provided by four outdoor boilers, each with a normal capacity of 450,000 lb. of steam per hour.



Electric Output Tops 1945 for First Time

Moving sharply upward, the production of electrical energy during the week ended August 10, 1946, reached a new high for the year, according to figures released by the Edison Electric Institute, and showed for the first time in more than a year an increase over the corresponding week of 1945.

The amount of electrical energy distributed by the light and power industry totaled 4,411,717,000 kw.-hr., comparing with 4,351,011,000 kw.-hr. during the preceding week. During the week ended August 11, 1945, the amount of electrical energy distributed amounted to 4,395,337,000 kw.-hr., this year's figure representing an increase of 0.4 percent. For the week ended August 3, the decrease from the corresponding week of 1945 was 1.8 percent.

Five of the seven major geographical regions of the country showed increases, the Middle Atlantic and the Southern states entering the plus column with an increase of 0.3 percent in both cases.

Weekly Output Millions Kw.-Hr.

1946		1945		1944	
Aug. 10	4,412	Aug. 11	4,395	Aug. 12	4,415
Aug. 3	4,351	Aug. 4	4,432	Aug. 5	4,399
July 27	4,352	July 28	4,435	July 29	4,391
July 20	4,293	July 21	4,385	July 22	4,381
July 13	4,156	July 14	4,295	July 15	4,377
July 6	3,741	July 7	3,978	July 8	3,941
June 28	4,133	June 30	4,353	July 1	4,327
June 22	4,129	June 23	4,358	June 24	4,325
June 15	4,030	June 16	4,348	June 17	4,287
June 8	3,920	June 9	4,327	June 10	4,265
June 1	3,741	June 2	4,204	June 3	4,144
May 25	3,942	May 26	4,330	May 27	4,292

Precent Change from Previous Year

	Aug. 10	Aug. 3	July 27
New England	+4.4	+5.3	+3.4
Mid-Atlantic	+0.3	−2.0	−0.4
Central Industrial	−1.0	−3.6	−4.6
West Central	+6.7	+2.8	+2.6
Southern States	+0.3	−2.3	−1.7
Rocky Mountain	+9.9	+6.2	+8.5
Pacific Coast	−2.8	−3.6	−4.5
Total United States	+0.4	−1.8	−1.9

SEC Rulings

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

CAMBRIDGE ELECTRIC LIGHT CO. has received permission to issue and sell to New England Gas & Electric Association, its parent, 3,400 shares of $25 par common stock at $150 a share, the price fixed by the Department of Public Utilities of Massachusetts by its order of June 28, 1946. The proceeds of the sale will be used to pay outstanding indebtedness of $500,000 to the First National Bank of Boston. (Release No. 6807).

CONSOLIDATED ELECTRIC & GAS CO.'s proposal to reduce interest rate on $12,885,000 bank loan from 2¾ percent to 2¼ percent, effective as of July 1, 1946, has been approved. (Release No. 6825).

WESTERN TEXAS UTILITIES CO.'s proposal to sell to Southwestern Public Service Co. its electric, ice and water properties in four west Texas counties in the Dalhart and Texline areas of Texas for $2,135,000 has been approved. Proceeds of the sale, to the extent of $1,809,474, will be used by the company to purchase 25,643 shares of its own preferred stock from its parent, American Public Service Co. Balance will be invested in company's utility plant or used for such purposes as the SEC will approve. (Release No. 6830).

NEW ENGLAND GAS & ELECTRIC ASSOCIATION'S application relating to conditions covering issuance of $22,500,000 of series A 20-year collateral trust sinking fund bonds and 2,300,000 shares of common stock has been approved. The conditions, defined by the company in an amendment to recapitalization plan, provide that the bonds be issued under an indenture between the utility and Old Colony Trust Co., Boston, as trustee, and be secured by the common stocks of New England's subsidiaries operating in Massachusetts and by temporary collateral consisting of $1,000,000 of U. S. Government bonds and 23,361 shares of Western Massachusetts Companies. If stock of latter company should be sold, proceeds must be invested in Government bonds and deposited as part of temporary collateral. Other conditions prescribe fiscal standards company must meet before floating additional bond issues, compel subsidiary companies to satisfy 15 percent of net revenues for maintenance and replacement, and limit payment of cash dividends of New England Gas & Electric common stock. (Release No. 6822).

REPUBLIC SERVICE CORP.'s plan for recapitalization together with that filed by I. H. Isaac a preferred stockholder, have been rejected by the commission. Both plans denied participation to common holders, the commission having already decided that such stock had no equity in assets of the company. The commission allowed the sponsors of both plans 30 days in which to file amendments which it felt were necessary. To summarize, the company's plan proposed to convert bonds and preferred stock into a new single class of $15 par common. Of the 120,000 shares of new common to be authorized, 114,590 would be issued in exchange for outstanding bonds and preferred stock on the basis of 97,009 shares, or 84.66 percent, to bondholders at rate of 11 shares for each $200 principal amount, and 17,581 shares, or 15.34 percent, to preferred stockholders on a share-for-share basis. Under stockholder's plan, bondholders would be paid in cash in full from proceeds of sale of $1,300,000 debentures, a $100,000 note and sale of 35,162 shares of new $10 par common. The company also would issue new common to the preferred stockholders at rate of two shares for each preferred share held. The commission stated that it believed both plans properly denied participation to common stock, and suggested that a capital structure consisting of debt of $1,000,000 or less and of common stock would meet requirements of the Holding Company Act. The commission stated that it believes a capital structure retaining some debt is permissible for the holding company. The commission rejected, however, the company's plan for an all-common stock basis on the ground that it would require the junior interests to make a substantial sacrifice. There is, SEC stated, a feasible alternative of recapitalization which, by retention of a certain amount of debt in the system, would provide for cash payment to bond holders and would make available for equity interests a more substantial share of company's earnings. The commission said it could not approve the large amount of debt provided in the Isaac plan. (Release No. 6820).

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Sacramento Man Named to California Commission

Brig. Gen. Richard E. Mittelstaedt, for 14 years superintendent of the Division of Water of the City of Sacramento, has been appointed by Gov. Earl Warren to the California Railroad Commission.

General Mittelstaedt will fill the vacancy left by the resignation of L. Harold Anderson, president of the commission, to accept a vice presidency with the Pacific Gas & Electric Co.

Mittelstaedt has twice served as adjutant general of the California National Guard and took part in both World Wars. In World War I he saw action in France. During World War II he was assistant division commander of the 40th Infantry Division, then served as military governor of a group of islands in the Hawaiian Territory. He saw service at Guadalcanal, Bougainville and New Britain. His last commission was as commanding general at Fort Richardson, Alaska.

Harold F. Huls, appointed to the commission last November, has been chosen new president of the commission.

UTILITY REPORTS

	Net Income 1946	1945
†American Power & Light and subs	$23,050,317	$14,525,061
*Consolidated Edison (N.Y.) and subs	36,434,727	31,876,289
*Dallas Power & Light	1,731,433	1,474,513
*Idaho Power	1,610,014	1,478,454
*Iowa-Illinois Gas & Elec.	4,266,321	2,545,894
*Pacific Power & Light	673,380	580,760
*Southern California Edison	11,352,205	10,543,868
*Texas Electric Service	3,355,680	1,995,698
*Wisconsin Power & Light	2,186,859	1,306,354

* Twelve months ended June 30.
† Twelve months ended May 31.

Owners of Seized Utilities Ask Court to Oust Potvin

Shareholders of Montreal Light, Heat & Power, Cons., Montreal Island Power Co., and Beauharnois Light, Heat, & Power Co. have submitted a petition to Justice Elie Salvas in Practice Court to oust L. Eugene Potvin, chairman of the Quebec Hydro-Electric Commission, as a member of the three-man arbitration board appointed to fix the indemnity on the share values of the three companies expropriated by the provincial government in 1944.

Mr. Potvin, Quebec Hydro appointee on the board, has refused to resign, and Premier Duplessis has sanctioned his remaining on the board. The petitioners want the court to order his removal and his replacement by Quebec Hydro with another person.

Objections to Mr. Potvin are that by consulting with other commission members on the value of the shares he cannot exercise free and independent judgment on the value, that he is interested in favoring one of the parties and is biased in favor of Quebec Hydro, that when he was an employee of the province before joining the commission he made reports to the government and expressed opinions regarding the value of the companies seized, and that his appointment is in contravention of all fundamental principles of justice.

•

Texas Co-op Held Liable for Municipal Rental Tax

The attorney general of Texas has held an electric cooperative to be subject to a rental of 2 percent of its gross revenues imposed by a municipality although co-ops are exempt from excise taxes.

The question arose in the assessment of such a rental by Richland Springs against the McCulloch County Electric Cooperative, which recently purchased the Community Public Service Co., electric system there.

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Pay Raise in Arkansas

Salary increases totaling $438,000 affecting all the 1,600 employees of Arkansas Power & Light Co., and retroactive to June 1, have been approved. Increases for some 1,200 employees of the maintenance, operating and clerical forces are included in a new contract negotiated between the company and representatives of the International Brotherhood of Electrical Workers, which has been sent to international headquarters in Washington for final approval.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Locates Faults in Street Light Circuits

CHARLES E. WHITE

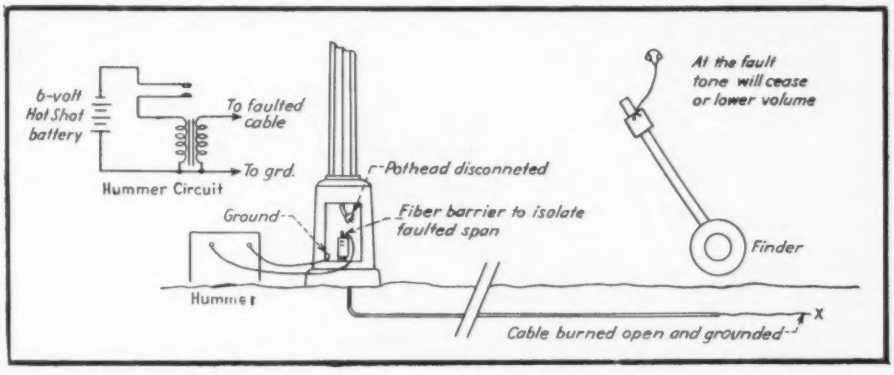
Engineer, Public Service Co. of Indiana, Inc., Terre Haute, Ind.

AN UNUSUAL NUMBER of cable failures on one of the boulevard lighting circuits of the Public Service Company of Indiana, Inc., prompted the engineering department and the service department to work on a device to trace the route of the cable and to indicate the location of the fault.

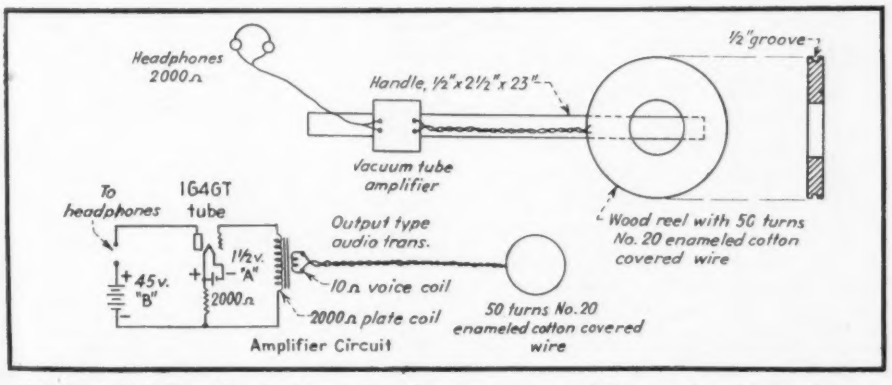
In the beginning, a number of bridge circuits were tried utilizing most known resistance, inductance and capacity tests, but they were difficult to set up and often gave erroneous fault locations, probably due to the lack of uniformity in the cable, when, for example, a 10-ft. section would be burned out.

It was then decided to use an exploring coil method, starting with some telephone cable exploring equipment borrowed from the local telephone company. This did not have enough power to follow a cable 2 ft. to 4 ft. underground so the final model of exploring coil had a one stage vacuum tube amplifier added to it. A vibrator furnishes a source of "tone" or interrupted high voltage known in telephone language as a "woodpecker" tone. A vacuum tube oscillator with sufficient power could be used to replace this, but has not yet been tried out.

The accompanying illustrations show how the equipment is attached to the faulted cable, which is, of course, isolated at each end of the run. In operation, a tone will be heard in the phones, due to coupling with the cable. When the fault is reached, the tone usually ceases or diminishes greatly in volume. When the operator becomes proficient in the use of this equipment it is not uncommon to locate the fault to within a foot.



TRACES CABLE FAULTS—Fault in buried street light cable is located by tracing signal tone impressed on cable by "hummer." Tone ceases or lowers in volume when in vicinity of fault



FAULT FINDER—Exploring coil with one stage amplifier used to locate faults in boulevard lighting circuits

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Electronic Relays—III*

One Thyratron Type

W. D. MACGEORGE

Director of Research,
Automatic Temperature Control Co., Inc.
Philadelphia, Pa.

IF THE cold cathode triode previously described for a relay circuit is replaced by a *Hot Cathode Thyratron,* several improvements in operation will result:

(a) Since most thyratrons have control grids which are quite sensitive, the control circuit voltage may be reduced to a few volts. This is often important because when it is desired to use very light moving contacts, the contact potential must be kept at a minimum to prevent the electrostatic forces present from causing contact chattering.

(b) The current available for relay operation is practically unlimited, with 100 ma. as a normal value for the smaller thyratrons.

Fig. 4 shows a typical circuit using a GL502A thyratron. The maximum relay current for this tube is 100 ma.

Bias is supplied to the grid by the 6.3-volt filament transformer T_1 and prevents the tube from firing. When control contacts S_1 are closed, the grid

* This series began in ELECTRICAL WORLD, July 20, 1946, page 87. Illustrations are numbered consecutively throughout the series.

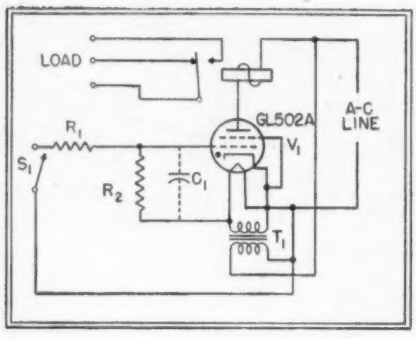


FIG. 4—Typical circuit with a thyratron

is returned directly to the cathode, the bias is removed and the tube will fire.

The rms. current flowing through the control contacts is given by the expression 6.3 volts/$(R_1 + R_2)$. If we assign a value of 2 megohms to $(R_1 + R_2)$, the control current will be $6.3/(2 \times 10^6)$ or 3.15 μa. Even lower currents are possible under certain conditions.

Resistor R_1 is placed in series with the grid to prevent any possible damage to this element due to the accidental connecting of a large external voltage source to contacts S_1. A value of 50,000 ohms is usually adequate.

Condenser C_1, shown in dotted lines, may be connected across R_2 to improve the phasing of the circuit and enhance its "snap acting" qualities. The addition of C_1, although its value is usually quite small, will increase the control current requirements slightly. A capacity value of 0.001 mfd. in parallel with a 2-megohm value of R_2 would permit a control current of 3.9 μa. to flow if the bias supply had a potential of 6.3 volts.

The circuit shown in Fig. 4 has one disadvantage. If its installation is not properly supervised, a short circuit or high grid potential may result. This difficulty results from the fact that one of the control contacts is connected directly to the supply line and if the other one becomes grounded, trouble may result. In order to avoid this difficulty, a transformer-isolated unit, such as that shown in Fig. 5, may be used.

The 100-ma. relay current capabilities of the GL502A tube are usually

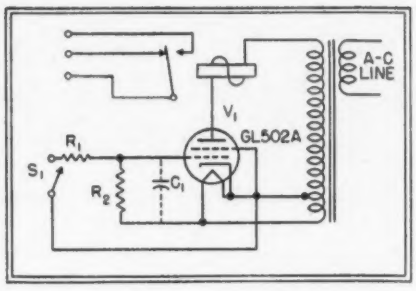


FIG. 5—Transformer isolated circuit

sufficient but it should be kept in mind that larger tubes handling amperes may be used without difficulty. For instance, the RCA 3D22 tube can be substituted directly in the circuit given in Fig. 4, without appreciably increasing the control current and with the ability to deliver 0.75 amp. of relay current. Units of this type could be called "electronic contactors" without stretching the imagination too far.

Applications of electronic contactors will appear in a subsequent issue and will outline operation of d.c. motors from a.c. circuits, and list industrial machines and process operations.

• • •

Indicators Show Supply Line Demand

J. L. HALEY

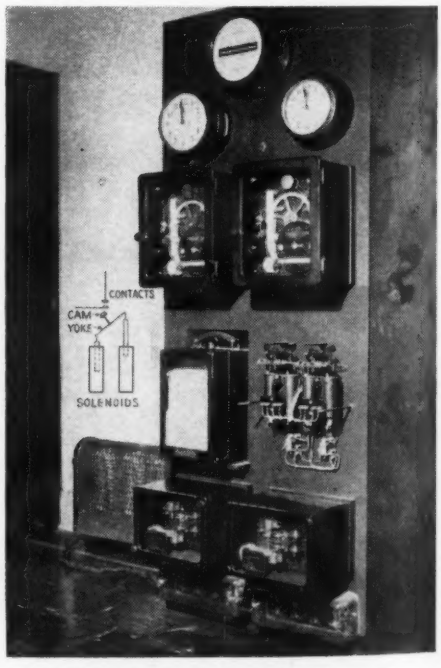
Supt. Electric Meter Dept., Memphis Light Gas & Water Div., Memphis, Tenn.

CONTACT OPERATIONS accumulated in any period on demand meters associated with two strategic transmission lines supplying the Memphis Light Gas & Water Division system are counted automatically by a unique relay arrangement and made to appear as illuminated numbers on visual indicators before the system load dispatcher. By this means the dispatcher, without leaving his desk, is kept informed of the progress of demand on these supply lines toward a maximum that might establish a new billing peak and can shift system load to reduce demand on either line.

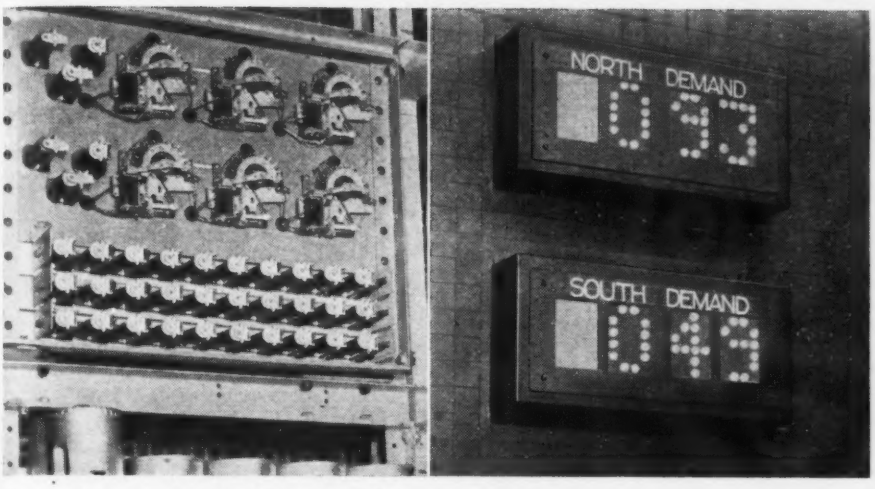
This degree of convenience was not always available. Before the indicators were installed contact operations representing north and south demand were accumulated on PD-5 printing demand meters which, for lack of space, were located behind the dispatcher's board. In order to keep track of the progress of demand on these supply lines, dispatchers had to leave their desks and go behind the board. Moreover, the dispatchers had to time these visits to the meters at frequent intervals during the very periods when departure from their desks was least desirable. The indicator was designed to eliminate this situation.

Heart of the device is a home-made "reciprocating relay" (of which there are two; one for the north, the other for the south PD-5 meters), which picks up contact operations of the PD-5 demand meter and passes them on to a pulse or contact counter consisting of rotary telephone relays. These contact counters operate display indicators on the dispatcher's board to reveal the number of accumulated pulses as lighted numerals.

Trick in developing the reciprocating relay was to design a contact making mechanism, for transmitting impulses to the pulse counter, that would remain closed for only a very brief



RECIPROCATING RELAYS — Contact operations of remote demand meters, recorded on two PD-5 printing demand meters (under clocks) are picked up and transmitted to illuminated display indicators on load dispatcher's board by individual reciprocating relays (lower right, cover removed). Insert shows schematic sketch of relay mechanism



IMPULSE COUNTER AND INDICATORS—Impulses from reciprocating relays are impressed on pulse counters consisting of rotary telephone relays (left) that operate separate display indicators (right) to show number of accumulated demand meter contact operations associated with two supply circuits. Indicators are on load dispatcher's board

interval. If the contacts remain closed too long or if they chatter, the telephone relays that do the counting will run up a false indication or become overheated.

Essentially the reciprocating relay consists of two solenoids with their armatures linked by a center pivoted yoke, as shown. Successive pulses from the PD-5 meter associated with each relay energize alternate solenoids, causing the tip first one way, then the other—reciprocate, in other words. Attached to the yoke of the relay is a cam which closes and opens the relay contact while traveling from one position to the other. The resulting impulses are fed into the rotary telephone relay, notching it ahead one position and in turn changing the numeral on proper indicator.

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Differential Protection

Delta-Wye Transformer Banks—II*

JOSEPH M. DE GUILMO

Substation Department, Public Service Electric and Gas Co.
Jersey City, N. J.

AT THIS STAGE the line currents in the primary and secondary transformer leads have been determined. Similar currents will flow in the current transformer secondaries. But Fig. 2 shows that the primary and secondary currents have a magnitude and phase angle difference. We cannot, therefore, have star-connected current transformers on both sides of the transformer bank, since the current entering the left restraining coil of the differential relay must be equal in magnitude and in phase with the current leaving the right restraining coil.

In order to bring this equality about, the observation is made that the phase and magnitude shift is caused by the fact that the bank has a star connection on one side and a delta connection on the other. The thought then arises that perhaps the current transformer secondary currents can be brought in phase by connecting the current transformers on the star side in delta and those on the delta side in star.

To prove that the above statement is the correct solution to the problem, refer to Fig. 1 (in Part I of this series). The current transformers on the delta side of the bank are connected in star as shown. This connection causes I_A to enter relay No. 1, I_B to enter relay No. 2, and I_C to enter relay No. 3. The current transformers on the star side must now be connected in delta in such a manner that the current leaving relay No. 1 will be equal to I_A, the current leaving relay No. 2 will be equal to I_B, and the current leaving relay No. 3 will be equal to I_C.

Since I_A must leave the right-hand restraining coil of relay No. 1, we will assume that it does and that it approaches a terminal L at which point we must make our delta current transformer connections in order to satisfy Kirchhoff's Law. From Fig. 2, it may be seen that

$$I_A + I_3 = I_1$$
$$I_A + I_3 - I_1 = 0.$$

In effect this equation states that I_A and I_3 must both flow towards point L, and I_1 must leave point L. To fulfill this requirement the polarity side of phase 1 current transformer and the non-polarity side of phase 3 current transformer must be connected to point L, thus allowing I_A to circulate through the restraining coils as shown.

Relay No. 2 has a current I_B entering the left-hand restraining coil. We must assume that an equal current I_B leaves the right-hand restraining coil and approaches terminal M at which point we must make another delta connection. From Fig. 2:

$$I_B + I_1 = I_2$$
$$I_B + I_1 - I_2 = 0$$

This equation states that I_B and I_1 must approach point M and I_2 must leave point M. In order to fulfill this requirement the non-polarity side of phase 1 current transformer and the polarity side of phase 2 current transformer must be connected to point M as shown.

Relay No. 3 has a current I_C entering the left-hand restraining coil. An equal current I_C must leave the right-hand restraining coil and approach terminal N at which point we must make the final delta connection. From Fig. 2:

$$I_C + I_2 = I_3$$
$$I_C + I_2 - I_3 = 0$$

This means that I_C and I_2 must approach point N and I_3 must leave point N. To fulfill the requirement, the non-polarity side of phase 2 current transformer and the polarity side of phase 3 current transformer must be connected to point N as shown.

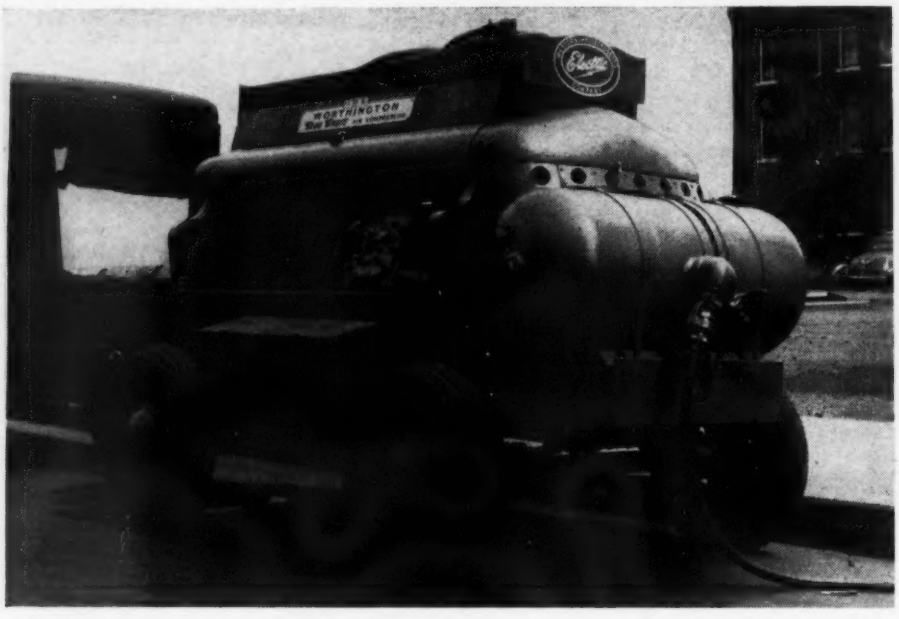
The wiring for the differential relays and current transformers is completed. The next problem is to prove the correctness of the connections.

* This four-article series began in ELECTRICAL WORLD, August 3, 1946, page 74.

Compressor Trailer Releases Truck Units

B. J. DOWD
Superintendent of Distribution, Springfield Division
Western Massachusetts Electric Co.

INSTEAD of mounting air compressor equipment on a regular line truck and thereby somewhat restricting the usefulness of this rolling stock, the Western Massachusetts Electric Co. recently decided to provide a trailer unit for this service, thus increasing the mobility of its trucks in the Springfield division. The unit consists of a Worthington "Blue Brute" air compressor with a capacity of 105 cfm. at 100 psi., mounted on a trailer as shown, with pneumatic tires. The approximate weight of the unit complete is 3,900 lb. Two air-operated tools can be used at a time and the trailer carries 200 ft. of 1-in. hose in a rack at the top. Normal speed of a truck-trailer combination is 20 to 25 mph., but this can be increased if necessary, as the trailer tows easily. Two boxes have been provided on the side to carry air guns and tools. The coupling is of the pindle hook type with safety catch. The gasoline tank has a capacity of 21 gal., and in winter the only extra precaution necessary is to change the oil to winter grade and fill the radiator with anti-freeze solution.



CLOSE-UP of compressor-trailer unit which saves tying up line truck equipment for part-time service in distribution department

The unit is convenient when setting poles in heavy gravel areas and has been used in shale rock ledge to great advantage. In representative service work the unit may be used two hours a day, releasing the hauling truck for other duties; but when used in main conduit line extension the outfit is likely to be in all-day service. Cost of the unit with tools was $3,000.

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Two Rotating Standards Determine Power Factor

JOHN BOWLES
Meterman, Illinois Power Co.
Granite City, Ill.

TWO identical rotating standards, the types used for testing watthour meters, can be used to determine the power factor of any 3-phase balanced load independently of the service meter. At unity power factor both of the meters register equally. At 50 percent one meter registers zero, and below 50 percent power factor it registers backwards.

The current coil of the standard should be suitable to carry the load that is being checked. For example, on an instrument transformer job the 5-amp. current coil of the standard would be suitable; on a 15- or 25-amp. self-contained meter job, the 25-amp. current coil of the standard would be the one to use.

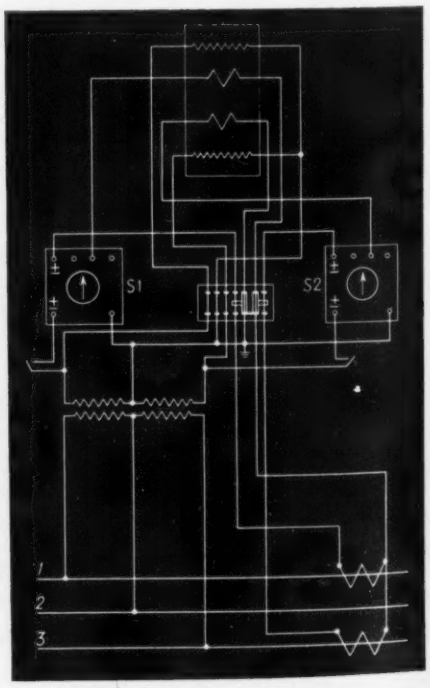
In power factor determination, both standards are started at the same time by closing both potential switches simultaneously, and are run long enough for a good reading, such as 70 to 100 revolutions on the faster running standard.

If an approximate power factor is needed, the ratio of the smaller to the larger of the two rotating standard readings is calculated and referred to the table to find the percent power factor. For example, if one standard reads 80 and the other 40, the ratio is 40/80 or 0.5; then referring to the table, the power factor is 87 percent.

When one of the standards runs

Value of power factor for the ratio of readings of two rotating standards

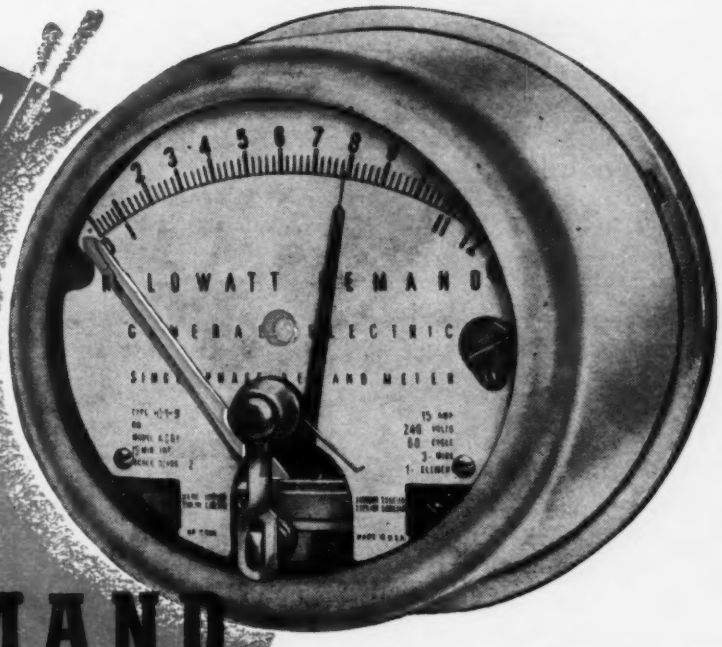
Ratio	P. F.	Ratio	P. F.
1.0	100	−0.1	42
0.9	99	−0.2	35
0.8	97	−0.3	29
0.7	96	−0.4	24
0.6	92	−0.5	18
0.5	87	−0.6	14
0.4	80	−0.7	10
0.3	73	−0.8	6
0.2	66	−0.9	3
0.1	58	−1.0	0
0	50		



CONNECTIONS for using two rotating standards (S1 and S2) to find the power factor of a 3-phase balanced load

New!

THERMAL WATT-DEMAND METER



Based on the *DIRECT-HEAT* Principle

You get three new features of operation with the radically different and unique G-E thermal watt-demand meter because it is built upon the "direct-heat" principle. Unlike meters of conventional design, in the new G-E meter the current passes *directly* through the bi-metallic spirals of the temperature-sensitive unit. Each spiral serves not only as a temperature-sensitive element, but also as its own electrical-resistance heater. There is no separate heating element. This means for you:

● **High operating torque (2660 gram millimeters)—Because the heat is generated *directly* within the temperature-sensitive bi-metallic spirals, operating torque for the same watt loss is much higher than that obtained in meters of conventional design. This makes possible the use of sturdy parts in the driving mechanism, which in turn assures long-life accuracy, indicating-pointer stability, and low maintenance costs.**

● **Ideal response-time characteristics—The new G-E thermal watt-demand meter, unlike those built with separate resistance elements, follows in operation the ideal exponential curve, which admits of simple definition and easy mathematical analysis.**

● **Accuracy of Indication—Pointer overshoot caused by continued transfer of heat from a separate resistance element after the load has been removed is eliminated.**

For complete information on this new development in the art of meter design, write today for "Thermal Watt-demand Meter GEA-4541," Apparatus Department, Schenectady, New York.

● **HIGH OPERATING TORQUE FOR:**

Sturdy parts

Long-life accuracy

Indicating-pointer stability

Low maintenance costs

● **IDEAL RESPONSE TIME CHARACTERISTICS**

● **ACCURATE INDICATION**

Direct-heat thermal element

THE FIRST IN A FAMILY OF G-E THERMAL DEMAND METERS

HEADQUARTERS FOR MEASUREMENTS

GENERAL ELECTRIC

backwards the power factor is below 50 percent. In this case the potential leads to that standard should be reversed so as to make it run forward. The ratio of the readings is found in the same manner as outlined above. However, the ratio should be considered negative when referring to the table for the power factor.

If the exact power factor is to be determined the formula used is:

$$\text{Cos } \theta = \frac{1}{\sqrt{1 + 3\left(\frac{W_1 - W_2}{W_1 + W_2}\right)}}$$

where cos Θ is the power factor and W_1 and W_2 are the revolutions of the faster and slower-running standards, respectively.

As an example, one standard makes 90 revolutions and the other makes 50; what is the power factor? By substituting in the formula:

$$\cos \theta = \frac{1}{\sqrt{1 + 3\left(\frac{90 - 50}{90 + 50}\right)^2}}$$

$$= \frac{1}{\sqrt{1.23}} = \frac{1}{1.1}$$

$$= 0.90 \text{ or } 90 \text{ percent power factor}$$

A fraction of a percent is dropped but this figure is close enough for practical work. Reference to the table shows that a ratio 50/90 or 0.555 gives about 90 percent power factor.

• • •

Cost of FM Radio Phone Units

FROM THE field data sheets of a prominent utility supplying electrical energy to a diversified area including, city, suburban and rural users are taken the following costs associated with the purchase and installation of 25 mobile two-way communications units and ten fixed stations in the territory employed for emergency and other necessary operation of the overhead and underground distribution and transmission system of the property. The over-all cost of the job was about $26,800. The costs of the fixed stations were $401 for each of two pick-up units, with a range of from $1,013 to $2,050 for the installations having two-way transmission. The work was completed in 1944, under war-time conditions.

Cost of Fixed FM Station at Operating Center

1 50-watt FM transmitter and receiver equipment, Link type, 39,660 kc	$701.39
1 FM control unit, Link type	200.00
1 FM antenna installation, Link type	60.00
Coaxial line, complete, ⅜ in., length 150 ft	52.30
1 Frequency monitor	122.90
1 Microvolter, Model C jack for external modulation, 20 to 100 mc	44.56
1 Crystal controlled signal generator	54.36
1 Output meter, type H	23.94
1 Inverter, 12 volts d.c. to 110 volts a.c., 100 watts	18.33
1 Preselector	18.35
Testing and checking installation, power company staff	514.16
Engineering and incidentals	239.30
Total	$2,049.59

Cost of Typical Pick-Up Station, Fixed Installation

1 Pick-up receiver, type 11 UF—a.c. for 115-volt, 60-cycles with 2 coaxial antennae, seals and gas fittings for ⅜-in. coaxial line	$235.00
Testing, checking and installing unit, above	130.00
Engineering and incidentals	36.58
Total	$401.58

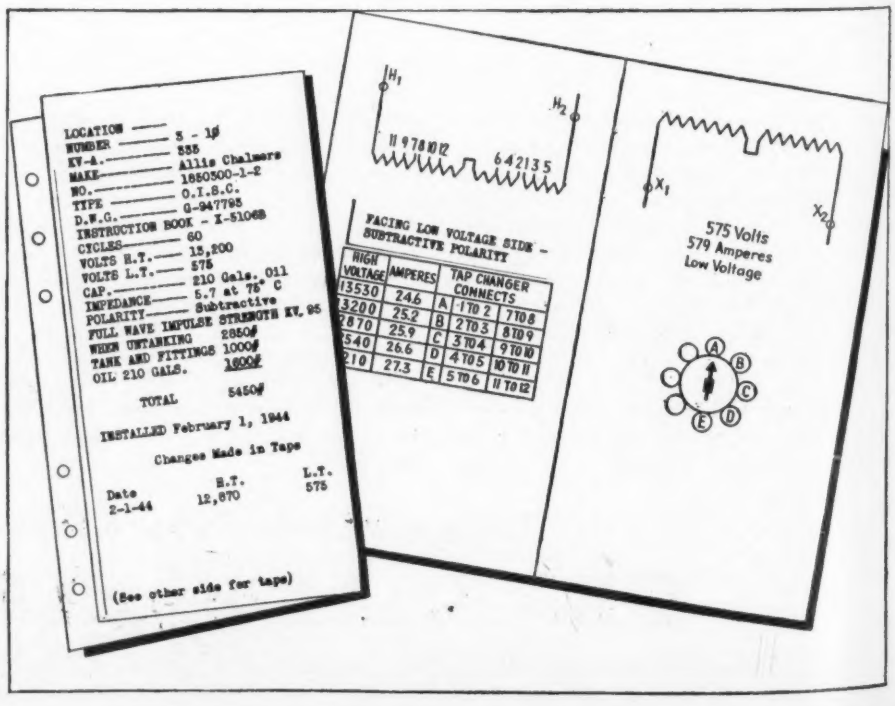
Cost of Mobile Units for Power Company Service

25 FM mobile units, Links type, complete with 35 watt transmitters and FM receivers	$11,038.34
23 mobile, Link type, whip antennae	126.50
Installation of Link transmitter and receiver in tank	35.00
Testing, checking and installing	1,401.50
Engineering and incidentals	1,555.77
Total	$14,157.11

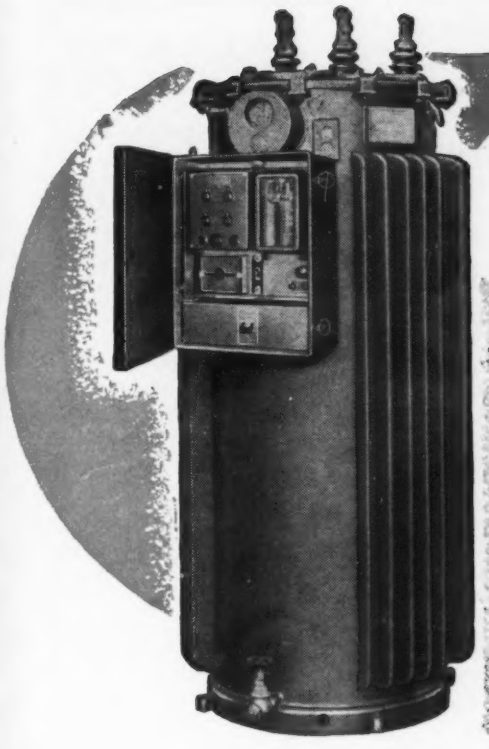
• • •

Recording Transformer Data

AN EASTERN power system employs a folding sheet of Lefax size to maintain a headquarters record for quick reference of name plate and tap changing data of all power transformers in its territory. While the data consist almost entirely of information carried by each transformer name plate in the field, the date and character of each tap change made are also recorded, and the sheets are filed alphabetically in two categories: Substation Transformers, and Customers' Transformers. Dates of installation and locations are included. The reproduction of the tap changing table, polarity data and details of primary and secondary winding tap contact terminals are useful for reference and save much time compared with checking these in the field in case the engineering information is required in connection with operating or design problems



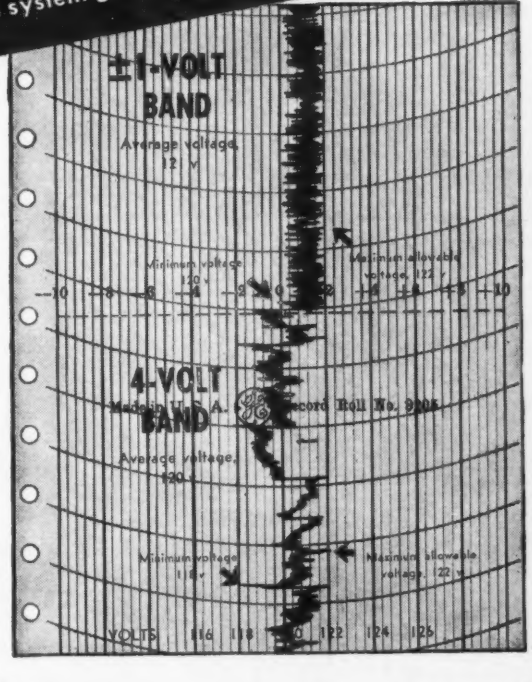
THERE'S PROFIT IN A G-E INDUCTION REGULATOR'S "Split-Second" ACCURACY



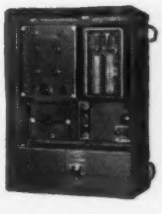
OPERATION records show that the ±1-volt narrow band width maintained by a G-E induction voltage regulator can recover lost revenue amounting to $1000 on a single feeder. Looking at it in other ways, the advantages obtained from this narrow band width can allow a 30 per cent feeder extension, an increase of 67 per cent in load—or a 1-volt higher average voltage at the customer's meter.

The narrower band width of a G-E induction voltage regulator can result in system economies which will pay for your regulator in a short time. Ask your G-E representative to show you how you can profit by using a G-E induction regulator, or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.* for Bulletin GET-1375 containing simplified charts which show you these gains.

± 1-volt precision band width — without time delay — gives control advantages that result in both revenue and system gains.


±1-VOLT BAND
Average voltage, 122 V
Minimum voltage 120 V
Maximum allowable voltage, 122 V
4-VOLT BAND
Average voltage, 120 V
Minimum voltage 118 V
Maximum allowable voltage, 122 V
VOLTS 116 118 120 122 124 126

THIS PRECISION VOLTAGE REGULATING RELAY REQUIRES NO TIME DELAY— INSTANT RESPONSE RESULTS IN A ±1-VOLT BAND WIDTH CONTROL



1. A G-E induction regulator, like an electric motor, has a rotor mounted on roller bearings. It can operate an indefinite number of times without perceptible wear.

2. The G-E voltage regulating relay causes the regulator rotor to make a precise adjustment whenever the voltage reaches the limits of the ±1-volt band width.

3. The G-E voltage regulating relay can be easily adjusted to meet your requirements of voltage level, band width, and holding effect, independent of one another. Once the settings are made, the relay can be relied upon to hold band width with unfailing accuracy

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Chart Guides Pole Class Selection

Rapid graphical determination of pole class requirements is possible with this chart which is adapted from the distribution construction standards of the Union Electric Co. of Missouri, St. Louis

H. E. OSTMAN, System Standards Engineer, Distribution Engineering Dept., Union Electric Co. of Missouri, St. Louis

ACCOMPANYING CHART for determining the class of pole required for a given loading condition with Grade "C" overhead construction is based on the schedule of "loading units" that have been assigned to various sizes and types of wire and apparatus to be supported by the pole.

Summation of the number of loading units corresponding to the number of conductors, cables, transformers, etc., from the schedule is one of three variables used in operating the chart. Other two variables are span length and the number of "unbalanced" services involved.

Example: Find the class of pole required when a 35-ft. distribution pole, 125-ft. span, supports four No. 6 primary conductors in the first gain, a 25-kva. transformer in the second and third gains, two No. 2 and one No. 4 secondaries in the fourth gain and a Bell $\frac{5}{16}$-in. str., $1\frac{3}{16}$-in. cable in sixth gain.

Summation of Loading Units

ITEMS	UNITS
4 No. 6 conductors	4
25-kva. transformer	¼
2 No. 2 and 1 No. 4 cond.	3
Bell cable	2½
Wind on pole	¼
Total	10

Enter the chart on vertical line for 125-ft. span of W. P. copper conductors, and at intersection with unit line No. 10 project horizontally across the chart to intersect with grade line. Drop down to read class 6 pole.

Charts have also been prepared for Grades "B" and "N" construction.

Schedule of Loading Units for Use With Pole Class Chart

W. P. Copper SIZE	UNIT	Bare Copper SIZE	UNIT	ACSR SIZE	UNIT
12	3/4	8	1	4-8	1
8	1	6	1	2-8	1
6	1	4	1	1/0-7	1
4	1	2	1	3/0-7	1-1/2
2	1	1	1-1/4	4/0-7	1-1/2
1	1-1/4	1/0	1-1/4	80,000- 9	1-1/2
1/0	1-1/4	2/0	1-1/4	336,400-33	1-1/2
2/0	1-1/4	3/0	1-1/4		
3/0	1-1/4	4/0	1-1/4		
4/0	1-1/4	500 Mcm	1-1/2		
500 Mcm	1-1/2				

Copperweld Copper SIZE	UNIT
8A	1
6A	1
4A	1
2A	1

Poles and Transformers ITEM	UNIT
Wind on Pole	1/4
Transformer (25 kva. max. 1-ph.; 7 1/2 kva. max. 3-ph.)	1/4

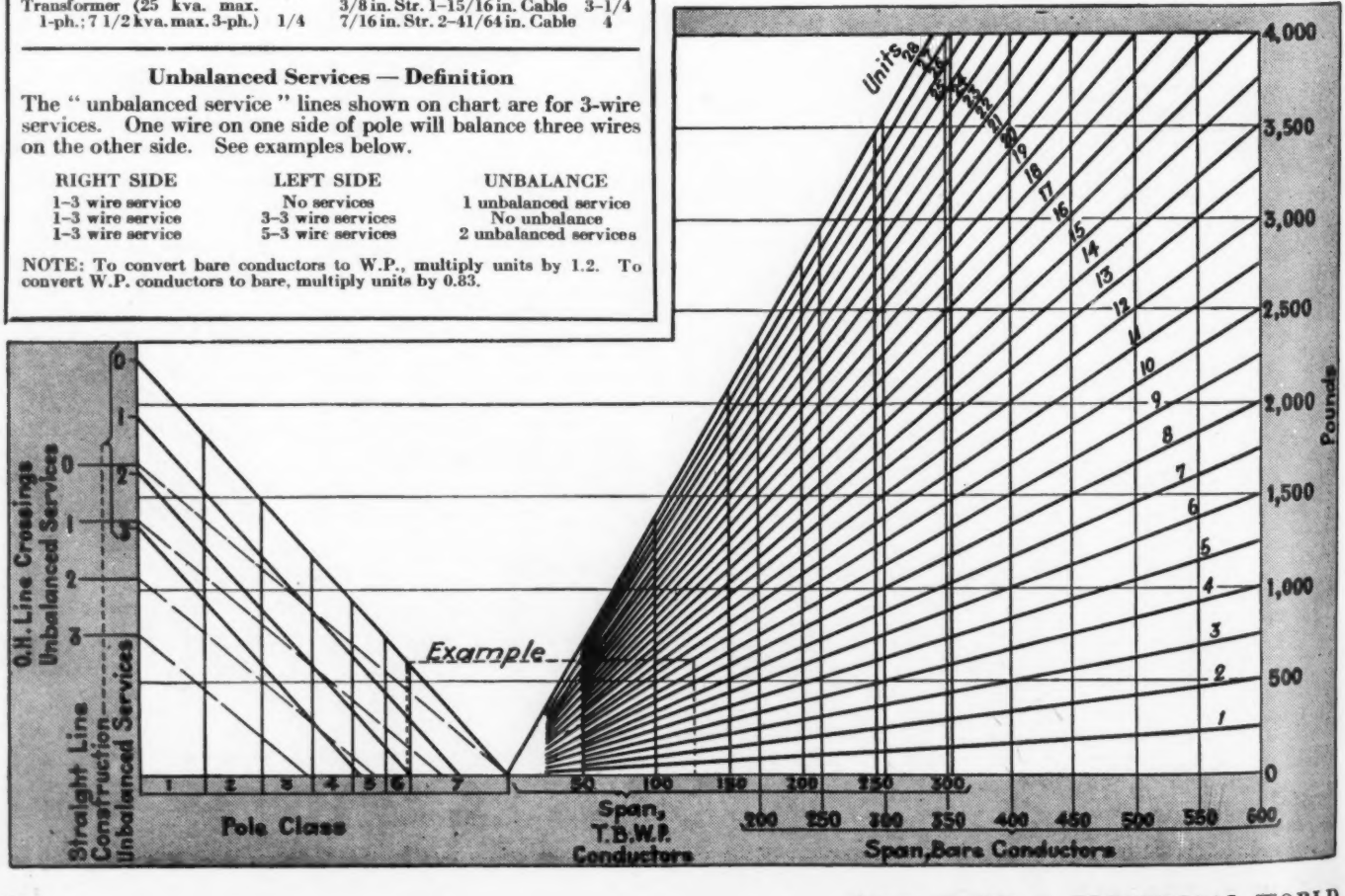
Bell Cable SIZE	UNIT
5/16 in. Str. 1-3/16 in. Cable	2-1/2
3/8 in. Str. 1-15/16 in. Cable	3-1/4
7/16 in. Str. 2-41/64 in. Cable	4

Unbalanced Services — Definition

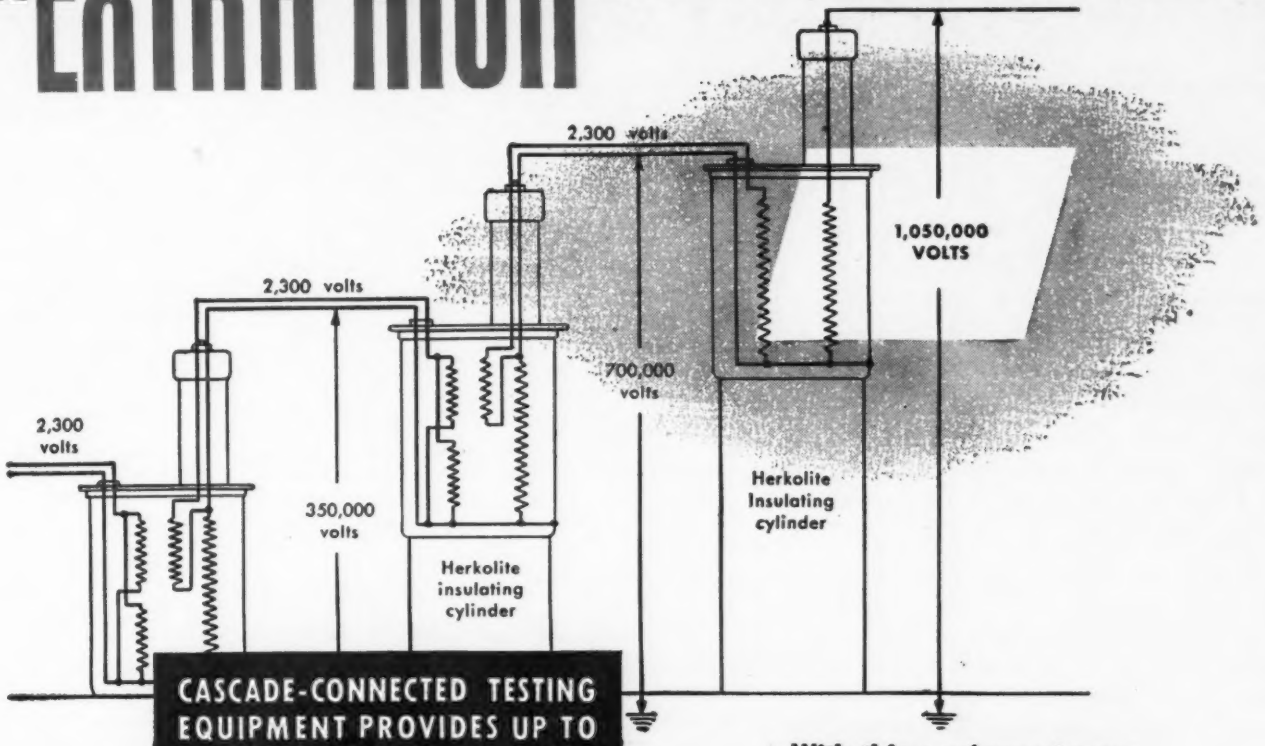
The " unbalanced service " lines shown on chart are for 3-wire services. One wire on one side of pole will balance three wires on the other side. See examples below.

RIGHT SIDE	LEFT SIDE	UNBALANCE
1-3 wire service	No services	1 unbalanced service
1-3 wire service	3-3 wire services	No unbalance
1-3 wire service	5-3 wire services	2 unbalanced services

NOTE: To convert bare conductors to W.P., multiply units by 1.2. To convert W.P. conductors to bare, multiply units by 0.83.



FOR EXTRA HIGH HIGH-POTENTIAL TESTS!



CASCADE-CONNECTED TESTING EQUIPMENT PROVIDES UP TO A MILLION VOLTS, OR MORE BY ECONOMICAL STEP-BY-STEP METHOD

★ **With this equipment you may have test voltages of one million or more volts**

EXTRA economy is one of the big benefits of the cascade method of obtaining extra high potentials for testing cables, ceramic and plastic insulations, and other high-voltage devices. The reasons: (1) Standard testing transformers and other auxiliary equipment are used to obtain the high voltages. (2) Step-by-step additions can be made to increase voltages even higher as the need arises. (3) The transformers may be connected in multiple for increased current output at lower voltages.

Cascade-connected equipment can be arranged for either intermittent, sustained, or even continuous voltage requirements. The addition of another testing transformer and *Herkolite insulating cylinder produces substantial increase in voltage.

EQUIPMENT INCLUDES

A typical installation includes separate testing transformers of the number required, motor-operated induction voltage regulator and control table, and circuit breaker with overload trip coils, control switches and indicating lights. For details on cascade arrangements for high-voltage testing equipments as they apply to your specific circumstances, write giving information on your requirements to *General Electric Company, 16-215, Pittsfield, Mass.* For free bulletin describing cascade and general-purpose test sets, fill in the coupon.

*Reg. U. S. Pat. Off.

GENERAL ELECTRIC

401-36-6186

Testing transformers, of the number required, in cascade arrangement provide potentials up to 1,050,000, at 1000 kva.

Motor-operated induction voltage regulator assures prompt control for correct test voltages.

Control table includes indicating meters for voltage and current, electric timing clock, switches, circuit breakers and indicating lights.

General Electric Company,
Apparatus Department, Sec. 401-36,
Schenectady 5, New York

Gentlemen: Kindly send me your free bulletin, GEA-4559, on Stationary A-C Testing Equipment arranged in cascade for high-potential testing.

Name.....

Organization.....

Address.....

City.....State.....

6186

Use of Kva.-Distance Constants For Voltage Drop Calculations

N. H. ERLANDSON, Distribution Design Engineer, Carolina Power & Light Co., Raleigh, N. C.

Tables list kva.-distance constants for 1 percent voltage drop for specific receiving end voltages. For other voltages multipliers are shown below each table. An explanation is included for the use of kw. instead of kva.

CONSTANTS for kva. per 1,000 ft. and kva.-miles were calculated from the approximate formula:

$$\text{Percent Voltage Drop} = \frac{\text{kva.}\ (R\cos\theta + X\sin\theta)}{10\text{kv.}^2}$$

Accuracy obtained by using the approximate formula depends upon the conductor size, spacing and power factor; but the results obtained by their use are well within acceptable limits, especially with the number of variables existing, such as the resistance value of the conductor at various temperatures, varying conductor spacings, the exact power factor of the load, and the exact voltage at the substation or at various locations along the line.

Example

The tabulated constants afford a quick method for determining percent voltage drop as shown in the following example:

Problem: Determine percent voltage drop for an 800-kva. load at 80 percent power factor, 3 miles from power source, No. 2 copper and 11,950 volts.

Solution: kva.-miles = 800x3 = 2,400.

Drop constant at 11,950 volts, 80 percent power factor and No. 2 copper = 1,235

$$\text{Percent Voltage Drop} = \frac{2{,}400}{1{,}235} = 1.94$$

To obtain kw.-distance constants in place of kva.-distance constants, multiply the latter by percent power factor. For example: Determine kw.-miles constant for No. 4 conductor at 80 percent power factor and 11,950 volts; then 905x0.8 = 724.0.

KVA.— DISTANCE CONSTANTS FOR 1 PERCENT VOLTAGE DROP

Copper Cond., size	95% PF Kva. per 1,000 ft.	95% PF Kva.-miles	90% PF Kva. per 1,000 ft.	90% PF Kva.-miles	85% PF Kva. per 1,000 ft.	85% PF Kva.-miles	80% PF Kva. per 1,000 ft.	80% PF Kva.-miles	70% PF Kva per 1,000 ft.	70% PF Kva.-miles	50% PF Kva. per 1,000 ft.	50% PF Kva.-miles	40% PF Kva. per 1,000 ft.	40% PF Kva.-miles
3-Phase, 2,300 Volts, 37-in. Spacing														
8	79	15	80	15	83	16	86	16	93	18	115	22	132	25
6	121	23	121	23	123	23	127	24	135	26	158	30	176	33
4	182	34	179	34	179	34	181	34	187	35	210	40	227	43
2	267	51	257	49	251	47	248	47	250	47	265	50	278	53
1/0	378	72	350	66	335	63	327	62	319	60	321	61	329	62
2/0	446	84	404	76	383	73	370	70	353	67	348	66	350	66
3/0	519	98	464	88	434	82	413	78	389	74	375	71	375	71
4/0	601	114	524	99	485	92	460	87	427	81	401	76	398	75
250,000	665	126	574	109	524	99	494	94	456	84	423	80	417	79

Drop Multipliers for Different Receiver Voltages

Receiver Voltage	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2700
Drop Multiplier.	1.32	1.26	1.2	1.12	1.09	1.02	1.00	0.96	0.92	0.88	0.845	0.815	0.782	0.725

3-Phase, 4,000 Volts, 37-in. Spacing														
8	238	45	243	46	250	47	259	49	282	53	348	66	398	75
6	362	68	364	69	370	70	380	72	404	76	475	90	529	100
4	545	103	538	102	538	102	542	103	561	106	630	119	681	129
2	802	152	770	146	752	142	745	141	749	142	794	150	835	158
1/0	1134	215	1051	199	1004	190	980	188	956	181	962	182	986	187
2/0	1336	253	1212	229	1150	218	1110	210	1058	200	1044	198	1051	199
3/0	1556	295	1392	264	1301	246	1240	235	1167	221	1126	213	1126	213
4/0	1803	342	1571	298	1456	276	1380	261	1280	242	1202	228	1193	226
250,000	1994	378	1723	326	1571	298	1483	281	1368	253	1270	240	1250	237

Drop Multipliers for Different Receiver Voltages

Receiver Voltage	3700	3750	3800	3850	3900	3950	4000	4100	4200	4300	4400	4500	4600	4800
Drop Multiplier.	1.17	1.14	1.11	1.08	1.05	1.03	1.00	0.952	0.907	0.865	0.827	0.790	0.756	0.694

3-Phase, 6,900 Volts, 60-in. Spacing														
8	705	134	718	136	738	140	763	145	826	157	1012	192	1154	219
6	1082	205	1085	206	1100	209	1123	213	1190	226	1369	260	1541	292
4	1614	306	1587	301	1582	300	1593	302	1642	311	1819	345	1960	372
2	2357	447	2246	426	2194	416	2174	412	2165	410	2278	432	2381	451
1/0	3307	627	3052	578	2921	554	2834	537	2752	522	2737	519	2785	528
2/0	3903	739	3527	668	3307	626	3174	601	3033	574	2957	560	2976	564
3/0	4534	859	4035	764	3749	710	3553	673	3353	635	3174	601	3153	598
4/0	5215	988	4534	859	4140	784	3903	739	3634	688	3377	640	3353	635
250,000	5792	1097	4980	943	4534	859	4251	805	3903	739	3577	677	3527	668

Drop Multipliers for Different Receiver Voltages

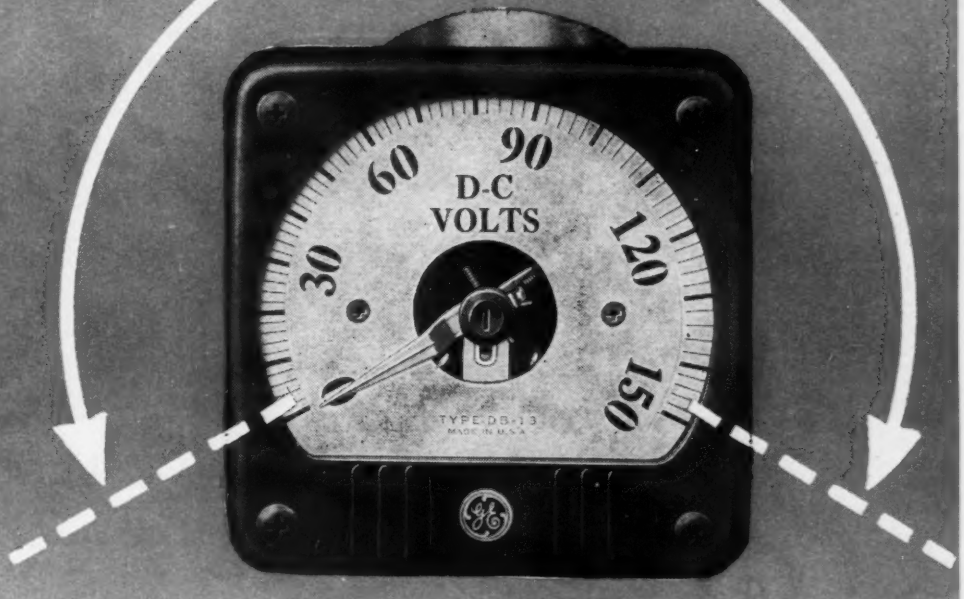
Receiver Voltage	6300	6400	6500	6600	6700	6800	6900	7000	7100	7200	7300	7400	7500	7620
Drop Multiplier.	1.20	1.16	1.125	1.09	1.06	1.03	1.00	0.975	0.945	0.92	0.895	0.87	0.845	0.82

3-Phase, 11,950 Volts, 60-in. Spacing														
8	2114	400	2154	408	2214	419	2289	434	2476	469	3035	575	3461	656
6	3246	615	3254	616	3299	625	3369	638	3571	676	4104	777	4622	875
4	4842	917	4761	902	4745	899	4777	905	4925	933	5452	1032	5878	1113
2	7071	1339	6737	1276	6582	1247	6522	1235	6492	1230	6834	1294	7142	1353
1/0	9919	1879	9156	1734	8763	1660	8502	1610	8256	1564	8209	1555	8353	1581
2/0	11708	2217	10580	2004	9919	1879	9522	1803	9098	1723	8871	1680	8927	1692
3/0	13603	2576	12104	2292	11246	2130	10659	2019	10058	1905	9522	1803	9459	1716
4/0	15644	2963	13603	2576	12420	2352	11708	2217	10903	2065	10130	1919	10058	1905
250,000	17376	3291	14940	2830	13603	2576	12753	2415	11708	2217	10731	2032	10580	2004

Drop Multipliers for Different Receiver Voltages

Receiver Voltage	10000	10300	10600	10900	11200	11500	11950	12100	12300	12500	12600	12800	13000	13200
Drop Multiplier.	1.425	1.325	1.27	1.19	1.14	1.08	1.00	0.975	0.945	0.915	0.900	0.872	0.845	0.82

a 4 1/4" instrument with a 7" scale



TYPES

AB-13—A-C

DB-13—D-C

VOLTMETERS
A-C & D-C

AMMETERS
A-C & D-C

WATTMETERS

VARMETERS

POWER-FACTOR
METERS

SYNCHROSCOPES

FREQUENCY
METERS

ALSO

Temperature
Meters

Tachometers

Easy to read—accurately

Concentric-scale instruments mean a 36 per cent longer scale in 40 per cent of the panel space—for that is the comparison between the G-E long-scale, 4¼-inch switchboard instrument and the conventional-scale, six-inch rectangular, semiflush switchboard instrument. Here is what the long (7-inch) scale, spanning 240 degrees, means to you:

For voltage—The extra length permits more precise control of station bus voltage. See how easy it is to read to one volt on the scale.

For current—Readings can be taken from full scale down to approximately 10 per cent of this value, thus extending the useful range.

For power—Wattmeters and varmeters not only have long scales, but the divisions are evenly spaced throughout—an added advantage contributing to more accurate readings.

For frequency—The 7-inch scale, calibrated 55-65 cycles, permits closer readings; more precise control.

For temperature—The scale, nearly twice as long as usual, permits closer watch over critical heating.

Other accuracy features—One per-cent accuracy rating, thorough shielding, antiparallax scale and pointer, and non-glare glass.

Insist on G-E concentric-scale instruments for all new installations. Write your nearest G-E sales office for Bulletin GEA-3432. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

HEADQUARTERS FOR MEASUREMENTS

GENERAL ELECTRIC

Basic Factors in Dielectric Heating—II*

Accompanying diagrams and tables continue data from a presentation by E. S. Winlund, Electronic Apparatus Division, Radio Corp. of America, Los Angeles, Calif., on certain relations in this field.

1. Effect of Airgap Modification. Refer to Fig. 1.

Minimum Heating Time =

$$T_0 = 1.13\, Z^{0.7} \times \frac{(t_2 - t_1)}{f} \times \frac{HD}{K \cdot PF} \text{ (seconds)}$$

(1) Obtain $K^2 Z_A^{0.7}$, where Z_A = airgap thickness in inches.
(2) If $K^2 Z_A^{0.7}$ is greater than $Z^{0.7}$, use it in place of $Z^{0.7}$ in the above equation for T_0.
(3) If not, the above equation for T_0 applies as is.

$$\text{Generator power} = P_G = \frac{WH\,(t_2 - t_1)}{0.57\, E_A T} \text{ (kilowatts)}$$

$$\text{Effective power factor with an airgap} = PF_A = \frac{PF}{\frac{Z_A}{Z} + 1} \text{ (percent)}$$

$$\text{Transfer efficiency with an airgap} = E_A = \frac{PF_A}{\frac{PF_A}{100} + \frac{1}{Q}} \text{ (percent)}$$

Sometimes, and usually for mechanical reasons, the use of an airgap is unavoidable. With substantial airgaps, the same minimum heating time formula as for contact electrode applies, but airgap thickness rather than material thickness controls, and the time is increased by as much as the square of the dielectric constant. For most common materials $K = 3$, so the minimum heating time can be ten times as long. Generator power is computed as before, but transfer efficiency is cut further by the airgap. This further reduction can be quickly obtained from the formula for PF_A.

2. Effect of Material Thickness, Using Fixed Airgap. Example: Generator, 27 Mc.; material, 1 lb. of Nylon 610, heat from 70 to 270 deg. F.; Z = 1/16 to 24 in.; Z_A = 1/4-in.

Thickness of material	*Minimum Heating Time to avoid flashover*	*Transfer Efficiency*	*Power required to heat material to 1 minute*
1/16 in.	50 sec.	55%	3.5 kw.
1/4	50	80	2.4
1	50	89.5	2.2
6	50	94.3	2.1
24	1.5 min.	95	.....

With a 1-in. thick Nylon block and constant airgap of 1/4 in. between one side of the material and the adjacent electrode, longer time and slightly more power are required in general. The constant 50-sec. minimum time is due to the constant 1/4-in. airgap, across which flashover must be prevented by taking at least 50 sec. Transfer efficiency is reduced, so that more generator power is required.

3. Effect of Varying Airgap on a Fixed Material Thickness. Example: Generator, 27 Mc.; material, 1 lb. of Nylon 610, heat from 70 to 270 deg. F.; Z = 1 in.; Z_A = Contact to 10 in.

Airgap thickness	*Minimum Heating Time to avoid flashover*	*Transfer Efficiency*	*Power required to heat material to 1 minute*
Contact	9.6 sec.	95%	2.0 kw.
0.008 in.	9.6	94.8	2.0
1/16	19.5	93.8	2.1
1/4	50.0	90.5	2.1
1	2.2 min.	80	.....
10	11.4	32	.....

Using a 1-in. thick block of Nylon and varying the airgap thickness, it appears that the introduction of even a very small airgap drastically lengthens the minimum time and to a degree reduces the efficiency. Also, airgaps large in comparison to the material thickness drastically reduce efficiency.

4. Effect of Varying Temperature on Heating Time. Example: Generator, 27 Mc.; material, 1 lb. of Nylon 610, heat from 70 to 270 deg. F.; Z = 1 in.; Z_A = 0.

Temperature	*Maximum Temperature rise rate*	*Transfer Efficiency*	*Power required for 200°F/min. heating rate*
77°F.	3.7°F./sec.	80.5%	2.4 kw.
182	21.	94.9	2.0

Little reliable data are available as to temperature effects, but the minimum time factor $HD/K \cdot PF$ varies widely for many dielectric materials. Expected results for the Nylon are shown. Faster heating is obviously obtained as the heat cycle advances. Data are unavailable for other temperatures. Foregoing Nylon computations are based on 182 deg. F. data. This temperature-sensitive behavior in vinyl resin film is partly responsible for its excellent high-frequency heat-sealing properties.

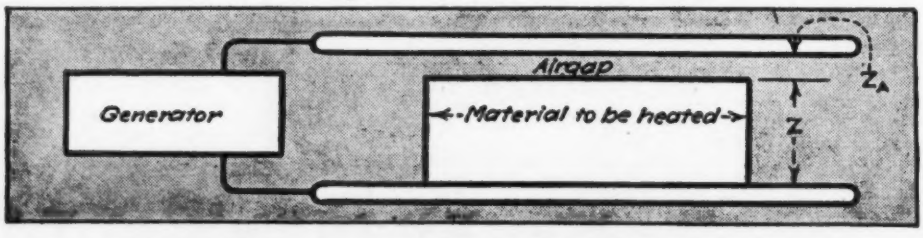
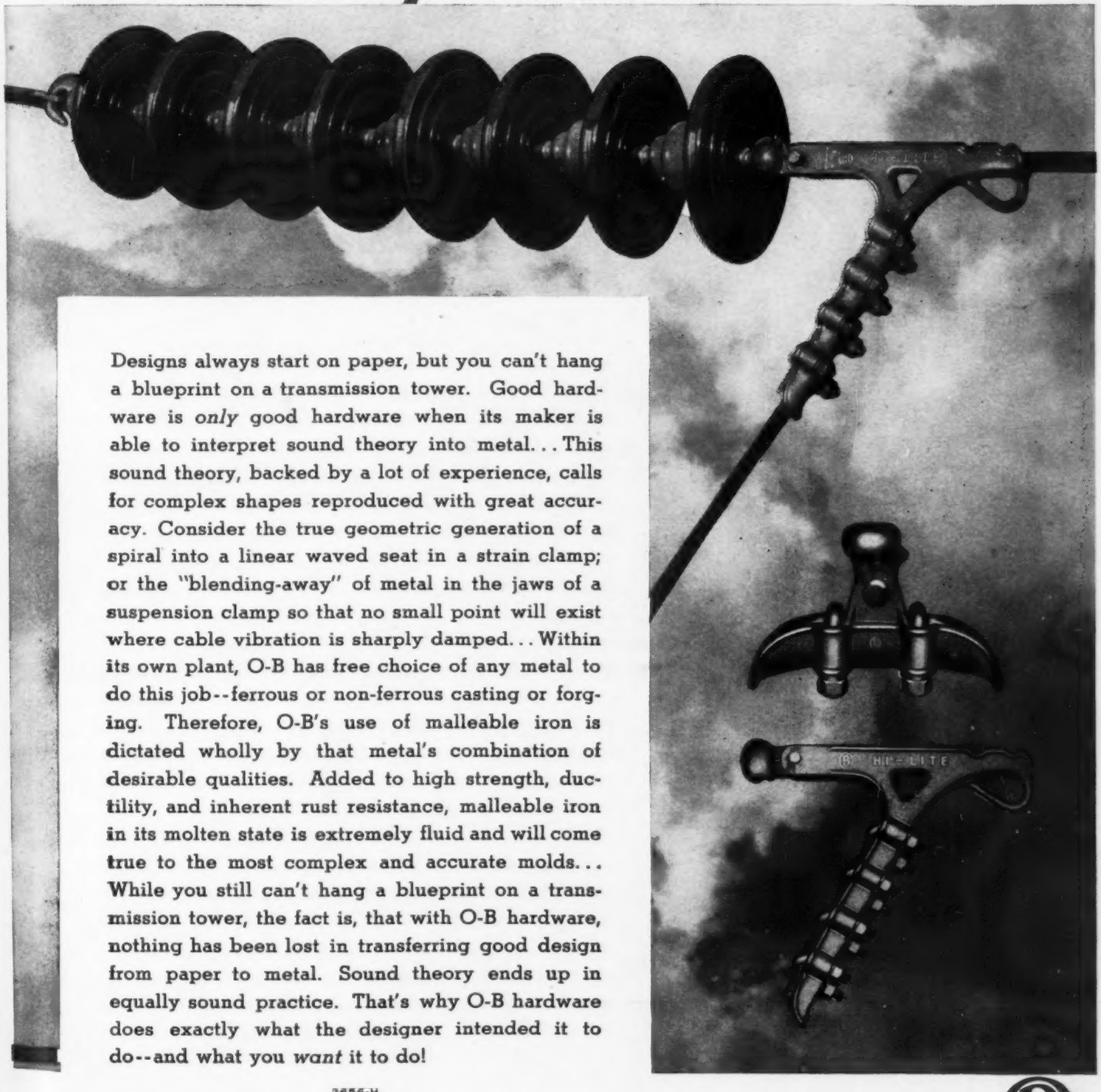


Fig. 1—Electrode arrangement for airgap dielectric heating

* This series began in ELECTRICAL WORLD, August 3, 1946, page 80.

Why *O-B hardware does what you WANT it to do*



Designs always start on paper, but you can't hang a blueprint on a transmission tower. Good hardware is *only* good hardware when its maker is able to interpret sound theory into metal... This sound theory, backed by a lot of experience, calls for complex shapes reproduced with great accuracy. Consider the true geometric generation of a spiral into a linear waved seat in a strain clamp; or the "blending-away" of metal in the jaws of a suspension clamp so that no small point will exist where cable vibration is sharply damped... Within its own plant, O-B has free choice of any metal to do this job--ferrous or non-ferrous casting or forging. Therefore, O-B's use of malleable iron is dictated wholly by that metal's combination of desirable qualities. Added to high strength, ductility, and inherent rust resistance, malleable iron in its molten state is extremely fluid and will come true to the most complex and accurate molds... While you still can't hang a blueprint on a transmission tower, the fact is, that with O-B hardware, nothing has been lost in transferring good design from paper to metal. Sound theory ends up in equally sound practice. That's why O-B hardware does exactly what the designer intended it to do--and what you *want* it to do!

2656-H

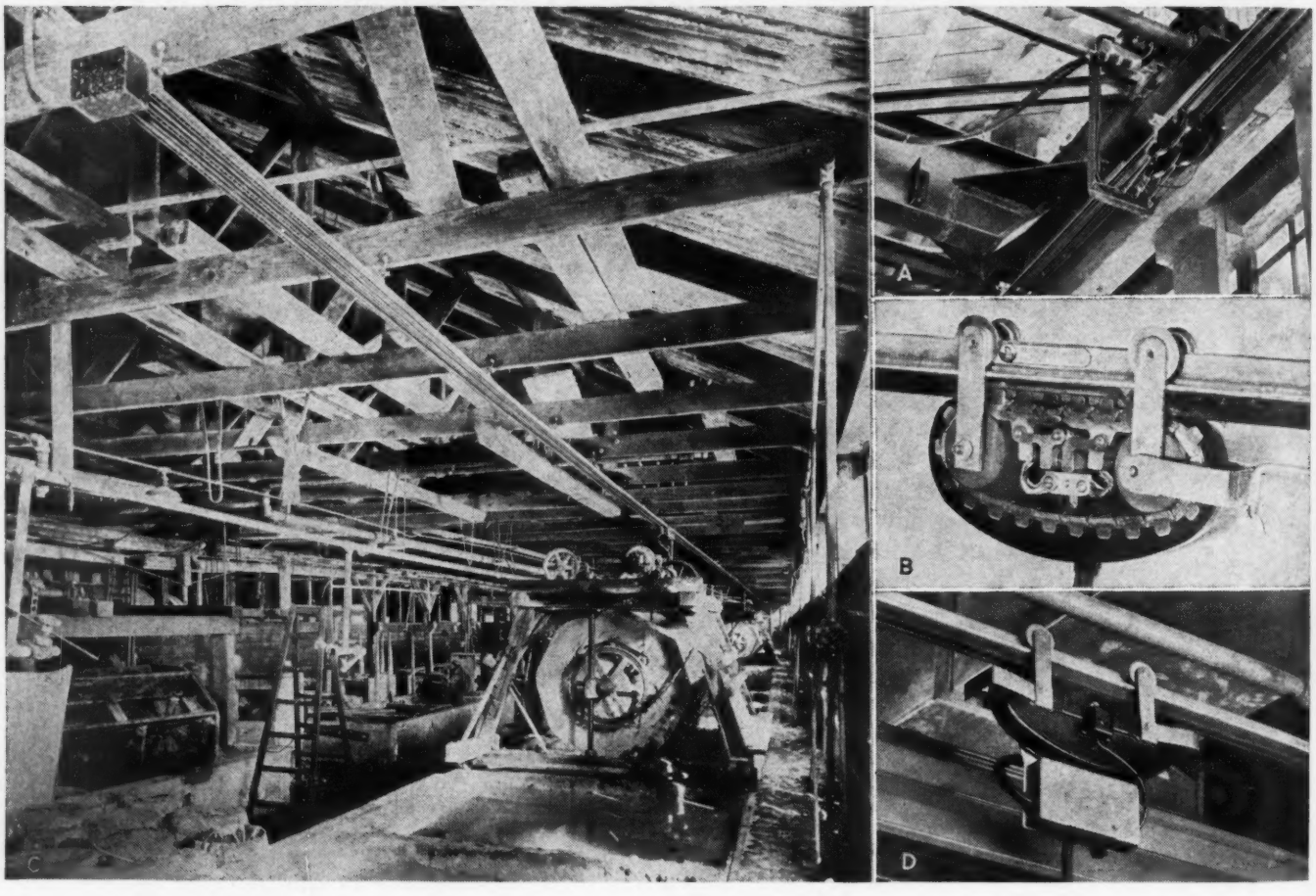
Ohio Brass HEADQUARTERS FOR PORCELAIN INSULATION

MANSFIELD, OHIO

CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

Crane Trolley Collecting Device Eliminates Industrial Accidents

Twenty-seven fatalities occurred in California industrial plants in past three years from exposed trolley wires. One of several devices for eliminating such hazards is described



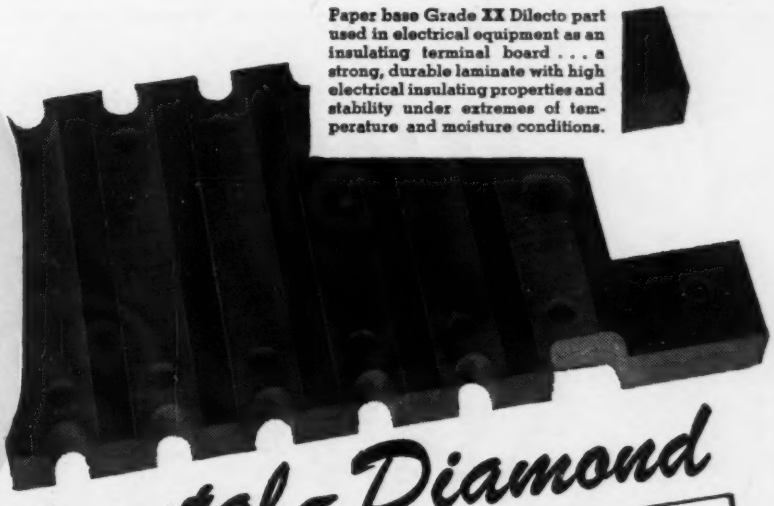
A—ONE OF MAJOR CAUSES of industrial accidents is removed with system of protecting trolley wires and shielding collectors . . . B—Cutaway view of rubber-protected trolley wire and caterpillar-toothed contact chain showing tow rod and lock key hanger as well . . . C—Tanneries find protected trolley system ideally suited to supplying 440-volt, three-phase power to de-hairing machines that move from tank to tank . . . D—Benbow Trac Troly permits mobile push button control for long lathes and other machines. One serious industrial accident occurred in California on a long lathe because operator could not reach motor control

ONE OF THE most prolific causes of electrical accidents in industrial plants is that of contact with crane and hoist trolley wires. Records of the California Industrial Accident Commission show that from 1943 to 1945, incl., there were 49 accidents attributable to contact with exposed current-carrying wires, rails, etc. Of these, 27 proved fatal. The California Code requires that contact systems be effectively guarded and a proposed revision of the new National Electrical Code reads such systems *shall* be protected.

One of several protective systems available is the Benbow Trac Troly shown. This insulated trolley wire and collector, manufactured in San Francisco, has a No. 1/0 trolley wire encased in a moulded rubber sheath with openings in the underside to match the teeth of the collector. The collecting device has a caterpillar type endless toothed chain that rotates around two idler sprockets as the device is moved with the crane or hoist. Six of the teeth are held in contact with the trolley wire at all times by automatic spring tension on the collector shoes. A difference in pitch between the teeth in the chain and the teeth sockets in the moulded rubber trolley wire protecting strip produces a wiping contact that insures uniform current pick-up capacity of 150 amp. at voltages up to 600, a.c. or d.c. The conductor is made up in standard 10-ft. lengths that are screwed together and supported by a lock key hanger.

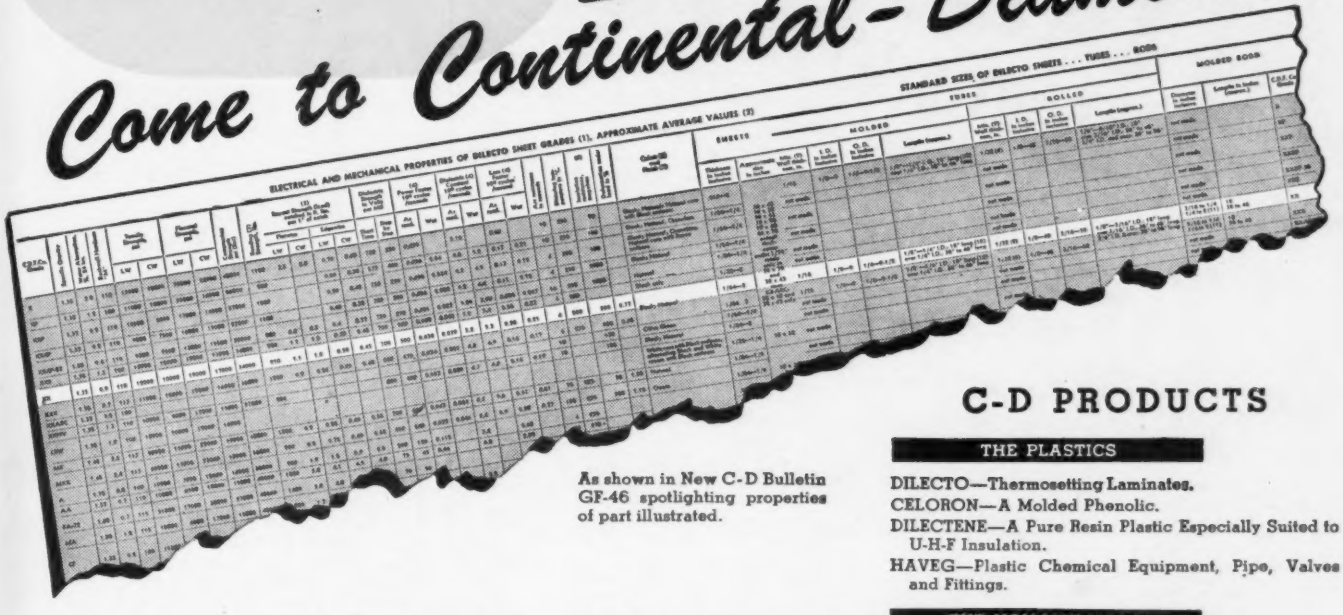
A number of installations have field tested the system, included among which are Hunter's Point and Mare Island Navy Yards, Alameda Air Base, Ames Aeronautical Laboratory, Steel Tank & Pipe Co., Lockheed and Doug-

For the "WHERE and HOW to use WHAT PLASTIC"



Paper base Grade XX Dilecto part used in electrical equipment as an insulating terminal board . . . a strong, durable laminate with high electrical insulating properties and stability under extremes of temperature and moisture conditions.

Come to Continental-Diamond



ELECTRICAL AND MECHANICAL PROPERTIES OF DILECTO SHEET GRADES (1); APPROXIMATE AVERAGE VALUES (2)

STANDARD SIZES OF DILECTO SHEETS . . . TUBES . . . RODS

As shown in New C-D Bulletin GF-46 spotlighting properties of part illustrated.

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The right time to decide what material to use is while your product is in the planning stage . . . before blueprints and detailed specifications are completed. Save yourself costly errors in production and performance by knowing in advance the non-metallic that best meets your required electrical and physical properties.

As a starter, send for our new Bulletin GF-46 which contains engineering data on the complete line of C-D insulating materials.

SEE OUR CATALOG IN SWEET'S

SEC-46

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A New Data Sheet, richly illustrated, has been issued giving new information about Simplex-PLASTEX insulated wire. It contains important information that will help you to select the right type of wire for your work. It contains engineering information which illustrates why no one plastic compound is satisfactory for all wire and cable uses and lends weight to our statement that to get best results, plastic insulation, like rubber compounds, must be designed for the job in hand.

A copy of this Data Sheet will gladly be sent without obligation. Write for your copy of Data Sheet #114 today.

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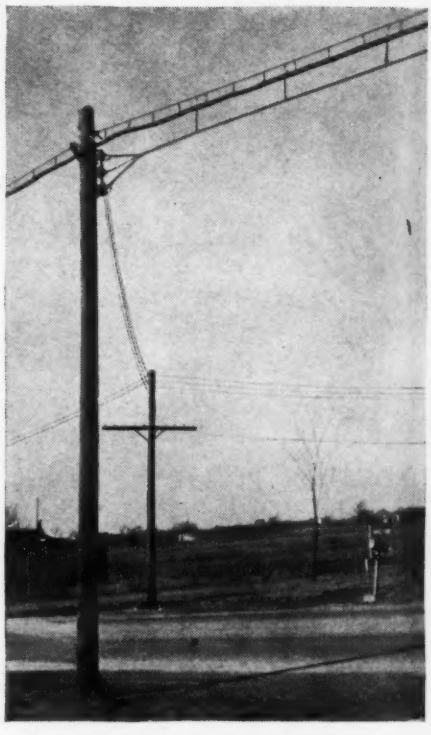
las Aircraft, and many others. The system is also widely used to serve portable tools and to provide mobile push button controls for long lathes, tools and machines.

•

Aerial Cable Reduces Hazard to Air Traffic



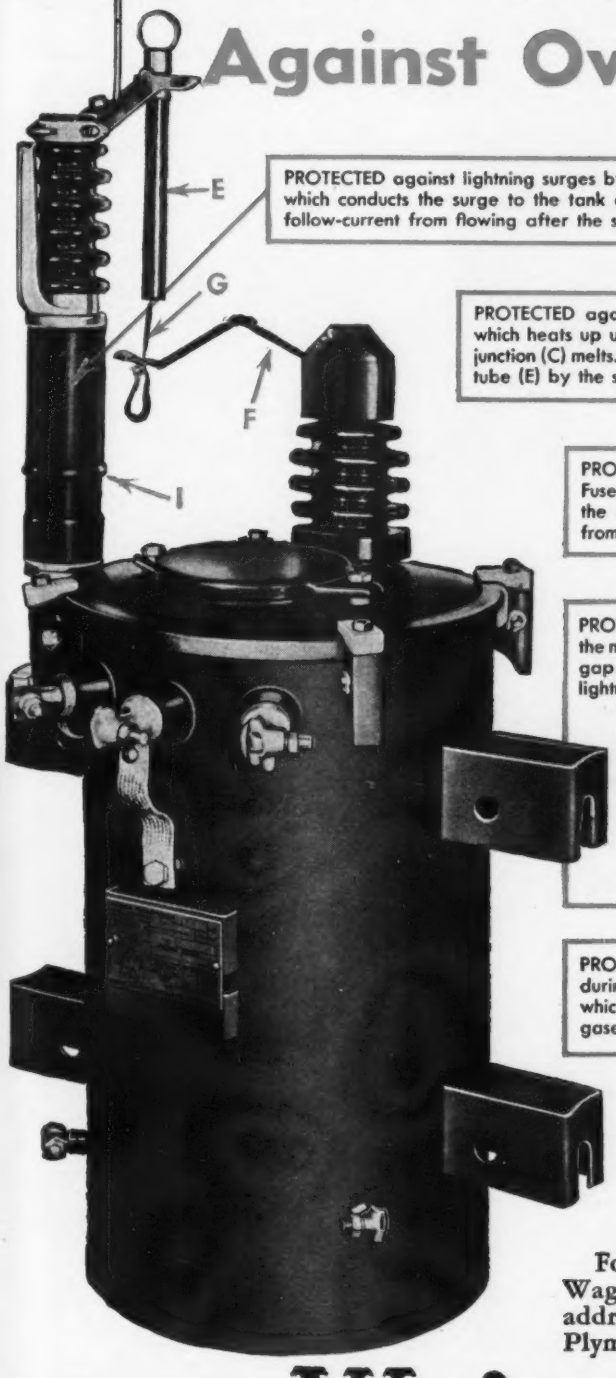
AERIAL AND SERVICE CABLE—Near a Milwaukee airport both primary and service cable, above, are suspended by marline hangers from the same steel messenger. The primary cable, which operates at 4,800 volts delta, was installed in 1929 and consists of unshielded trench-lay cable

AN AERIAL CABLE installation improvised from trench lay cable in 1929 is still in operation on the system of the Wisconsin Electric Power Co., Milwaukee. Originally installed adjacent to the Curtiss-Wright Airport outside the city, purpose of the cable run was to reduce the height at which conductors were carried and so minimize the hazard to air traffic.

Trench-lay cable used was purchased from the Rome Wire & Cable Co. and installed at the expense of the airport owners. It consists of three No. 6 conductors with rubber-compound insulation rated at 5,000 volts. The cable is unshielded and has an outer

FULLY PROTECTED

Against Overloads and Surges



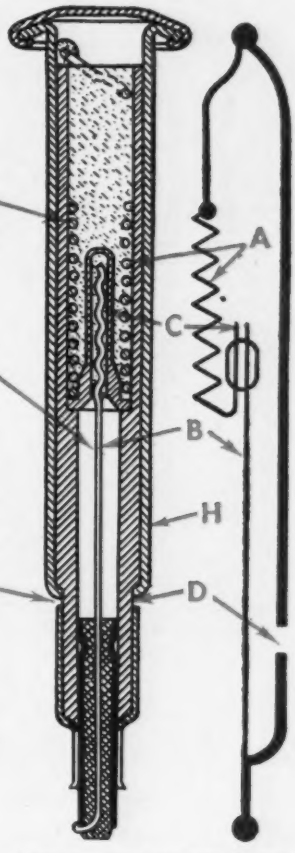
PROTECTED against lightning surges by this Joslyn expulsion-type lightning arrester which conducts the surge to the tank and to ground and then effectively prevents follow-current from flowing after the surge has occurred.

PROTECTED against continuous small overloads by Coil (A), which heats up under overload until the alloy at the coil-fuse junction (C) melts. The freed fuse (B) is withdrawn from the fibre tube (E) by the spring-actuated arm (F).

PROTECTED against a sudden heavy overload by Fuse (B). When the fuse blows and frees lead (G), the spring-actuated arm (F) withdraws the lead from the fibre tube (E).

PROTECTED against lightning-caused outages by the metal protective sheath (H) and the shunt spark gap (D). The function of the spark gap is to divert lightning surges around elements (A) and (B) so as to eliminate the chance of an undesired fuse outage from this cause. The impedance of the composite fuse link is so low with respect to 60-cycle current that the discharge in this relief gap does not persist after the surge current has subsided. Thus the transformer is kept on the line while the expulsion-type arrester (I) carries the surge to the tank and to ground.

PROTECTED against continuation of the arc formed during withdrawal of the lead by the fibre tube (E) which confines the arc until it is extinguished by gases generated within the tube.



Cross-section and schematic diagram of fuse-link device located in top of fibre tube (E).

T46-19

Wagner rural-line Type HEBF-EP Transformers are fully protected against (1) continuous small overloads, (2) sudden heavy overloads, (3) lightning surges, and (4) lightning-caused outages. This four-fold protection is accomplished by two protective devices: a lightning arrester and a fuse-link device described in the paragraphs and drawings above.

For full description of the HEBF-EP as well as other types of Wagner rural-line transformers, write for Bulletin TU-1C and address your request to Wagner Electric Corporation, 6456 Plymouth Avenue, St. Louis 14, Missouri.

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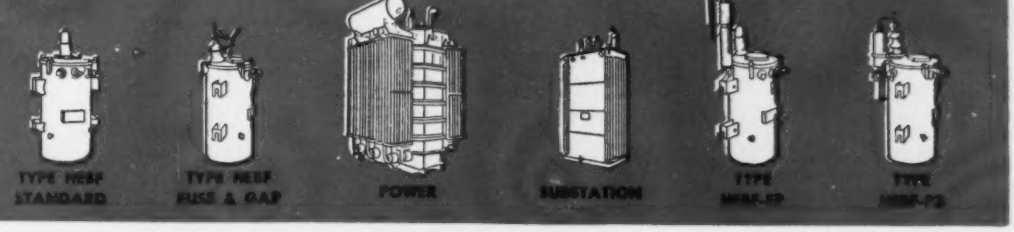

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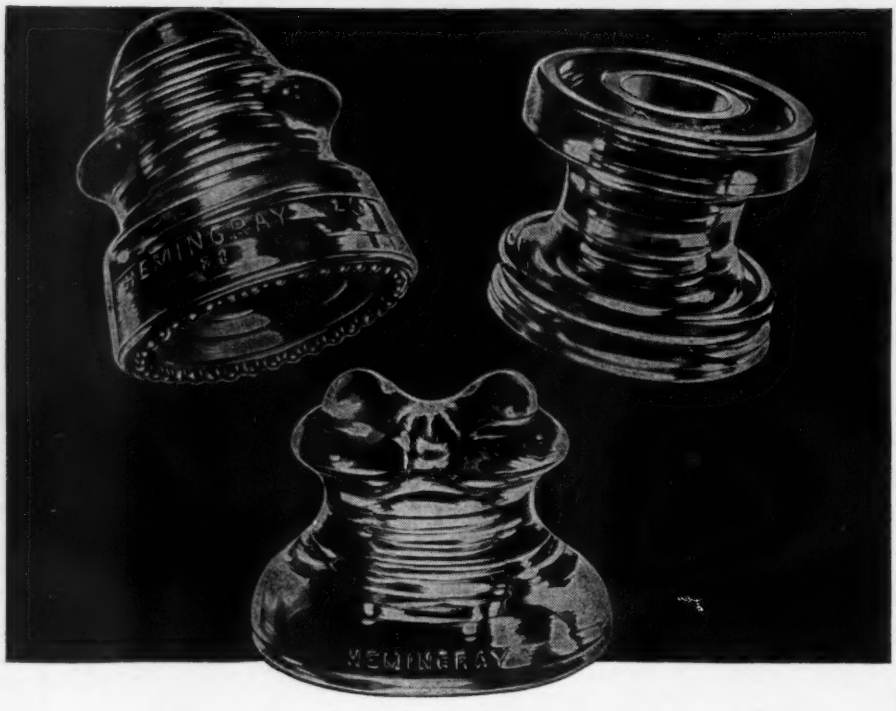

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There are ten Hemingrays for Secondary Power distribution with heights ranging from $2\frac{15}{16}$ to $5\frac{1}{32}$ inches and diameters from $2\frac{1}{4}$ to $3\frac{1}{4}$ inches.

Investigate! Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

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covering of sisal braid with asphalt compound impregnation. Marline hangers suspend the cable from a $\frac{5}{16}$-in. steel messenger throughout its length of about 1,000 ft. Cutouts for sectionalization are provided at each end of the 4,800-volt delta circuit.

To provide service to residences about midway of the run an aerial service cable is suspended by long marline hangers below the primary cable and from the same steel messenger, as shown. Where the two cables are carried on the same pole they are supported on opposite sides. The primary cable is hung from the messenger which in turn is held in a parallel-groove lamp fastened to a through-bolt. The service cable is tied into an insulator on the opposite side of the pole.

•

Door Latch For Street Vault Grating

RALPH W. COURSEY

Underground Engineer
Oklahoma Gas & Electric Co
Oklahoma City, Okla.

DOOR LATCH—Support for street vault gratings in open position is provided by simple latch arm

SUPPORT and latching in the open position is supplied by the door-latch design of Oklahoma Gas & Electric Co. for street vault gratings. As shown in the accompanying illustration and details, the principal fabricated part is an angle support with tension springs and latching triggers to engage notches in the latch arms.

The angle support is $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{1}{4}$ in. angle 16 in. long, with one

World-Wide Photo

Sure Cure for Hay "Fever"

With This New Electrical Resistance Thermometer

WATCH that hay! When it runs a temperature it may ignite and burn down the barn. That's spontaneous combustion and to prevent it an extremely sensitive Electrical Resistance Thermometer Bulb, developed by Edison-Splitdorf Corporation, is used to detect temperature changes.

Not only does this wonder bulb detect overheating in hay mows; it also determines ground and air temperatures in greenhouses — reports temperature changes in the bearings of power station generators, railroad cars, vital spots of airplanes, chemical reactions, hospital rooms and even in patients undergoing operations. Its uses are unlimited and it will measure temperatures ranging from −200° F to 600° F in solids, liquids and gases. Time constant is less than 2 seconds.

The heart of this bulb is a resistance element wound with a wire having a Temperature Coefficient of Resistance of .00636 per degree C. A change of 1° C produces a .39 ohms change in the unit which in turn produces a corresponding change in the current flowing through the recording meter.

Although this type thermometer has been used in industry for many years it was never successfully developed for volume production because of a lack of an adequate supply of a resistance wire with a stable T. C.

Spurred by the urgency of the war, Driver-Harris Metallurgists working with Edison Engineers speedily developed D-H 99 Alloy to meet this need. It is a resistance wire having a stable T. C. of .00636 per degree C when drawn to .002" diameter and available in large quantities with dependably uniform properties from spool to spool.

Today Driver-Harris manufactures over 80 electrical *heat and corrosion-resistant* alloys. If, like Edison-Splitdorf, the alloy wire you need has not been developed, tell us about it. We've solved many difficult metallurgical problems in 47 years.

1. STAINLESS STEEL BULB
2. PORCELAIN SEAL
3. D-H 99 ALLOY
4. SILVER SPRINGS
5. MICA INSULATION

Construction details of the temperature sensitive el ment which is hermetically sealed into the stainle steel bulb of the Edison-Splitdorf Electrical Resistan Thermometer. Made for the Foxboro Company an other instrument manufacturers.

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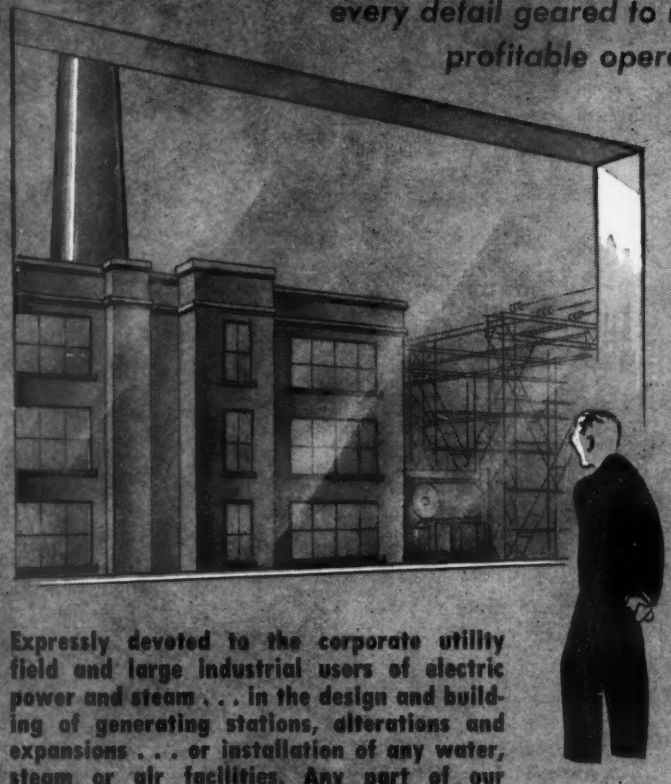

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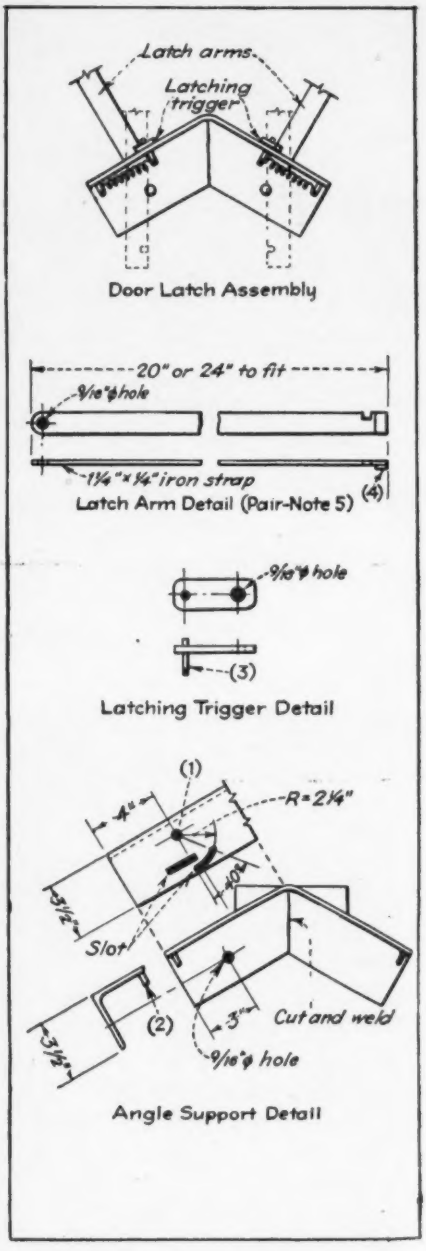
side cut and welded to shape. Slotted holes $\frac{5}{16}$ in. wide are cut in the upper face, as shown, with fabrication and dimensions the same on the opposite side. A rust-proof, closed coil type tension spring, approximately $3\frac{1}{4}$ in. over-all length with $\frac{3}{8}$ in. coil diameter, is used for each latch.



DETAILS of the door latch shown in accompanying picture. All steel parts are hot dip galvanized

Notes:

(1) Drill and tap for ½-in. brass machine bolt

(2) Pin—¼ in. by ¾ in. long welded to angle

(3) Pin—¼ in. by 1¾ in. long inserted in strap

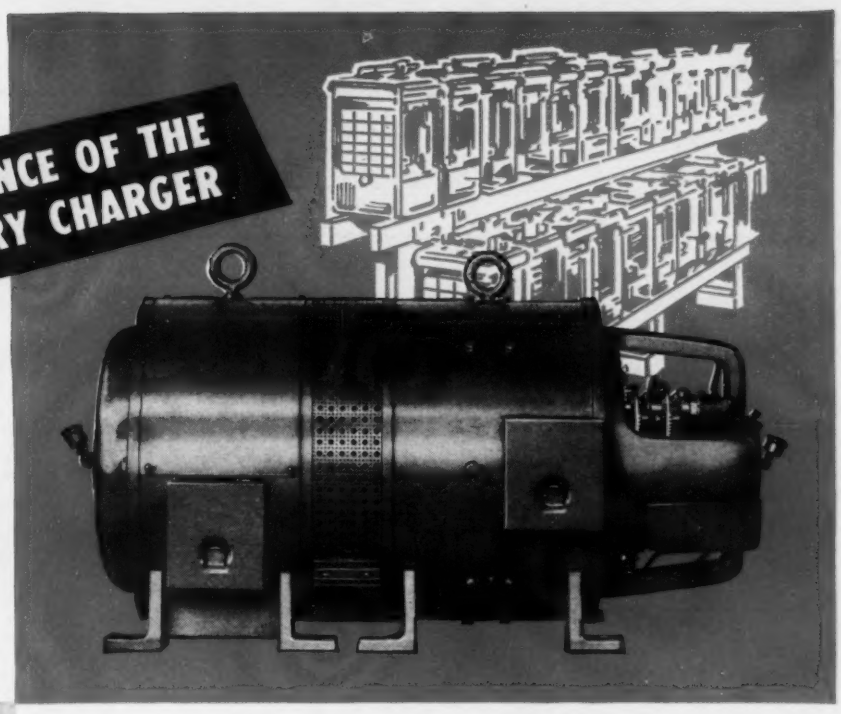
(4) Stop—weld ¼ in. by 1¼ in. iron strap to arm

(5) Latch arms—one as shown, other with notch opposite side

THE PROVED PERFORMANCE OF THE DIVERTER-POLE BATTERY CHARGER

Means

POSITIVE STANDBY BATTERY OPERATION



THE DIVERTER-POLE BATTERY CHARGER...

LENGTHENS Battery Life. Only the "constant-voltage" method of charging protects the Battery against overcharging. By inherently maintaining a constant voltage level, regardless of fluctuations in the load or a-c power supply, the Diverter-Pole avoids the need of frequent attention to a field rheostat, thus protecting itself and the battery from damage through oversight or carelessness.

PROTECTS itself against harmful overloads. As shown by the graph below, the Diverter-Pole changes from a constant-voltage machine into a constant-current one before overloads become dangerous.

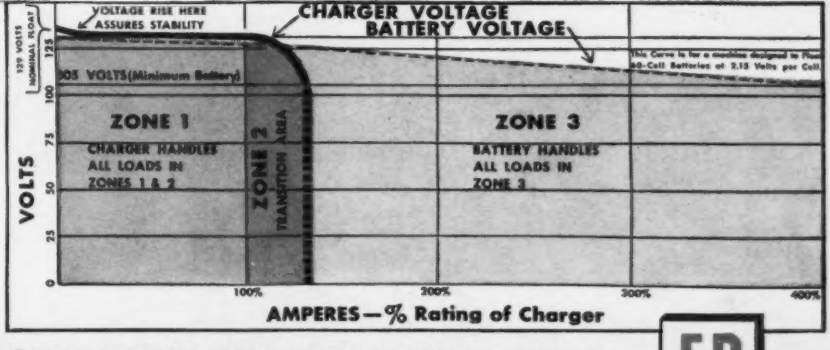
ASSURES full-automatic operation. Increasing use of Diverter-Poles in isolated automatic and supervisory-controlled substations is convincing evidence that this type of charger needs only occasional inspection.

Standby Batteries may not be called upon to perform for years, but when they are needed, there must be no question regarding their ability to open the station-protecting circuit breakers. Battery manufacturers take every precaution to build decades of service into their products, but once installed, battery operation depends almost 100% upon the Battery Charger.

The performance of the Diverter-Pole Charger has been proved by the thousands of installations made in the past 25 years. There is no better endorsement of this Charger than the list of its Users. *Ask for a copy of D.S. 320.*

BEFORE BUYING ANY BATTERY CHARGER, DEMAND POSITIVE PROOF OF TROUBLE-FREE PERFORMANCE

DIVERTER-POLE CHARGERS ARE AVAILABLE IN CAPACITIES FROM 250 WATTS TO 200 KILOWATTS; IN VOLTAGES FROM 5 TO 500 VOLTS AND FOR ANY STANDARD POWER SUPPLY.



Write **FOR DESCRIPTIVE BULLETIN No. 96-A**

EP X-13

THE ELECTRIC PRODUCTS COMPANY

1731 CLARKSTONE ROAD CLEVELAND 12, OHIO

LOAD BUILDING

Portland Hotel Installs Complete Electric Kitchen

CHEF AND COOKS are most enthusiastic over new heavy-duty electric cooking equipment in a Portland hotel. So is the customer, because improved load factor on combination rate makes his monthly cooking bill only $144

HEAVY-DUTY electric cooking equipment with connected load of 177 kw. has recently been installed in the Multnomah Hotel in Portland, Ore., displacing oil and gas in this modernized eight-story, 200- by 200-ft. hostelry. Major equipment consists of: Five 22-kw. ranges as shown; one 10.5-kw. broiler unit; one 18-kw. deep fry unit; two 4-kw. griddles, as well as one 12.6-kw. and one 18-kw. deck-type pastry ovens.

Measured maximum demand is 90 kw. which occurs between 6 and 7 in the morning. Even this moderate demand will be reduced by a little different procedure in warming up in the morning. Estimated monthly consumption and bill for electric cooking only are 21,000 kw.-hr. and $144, respectively.

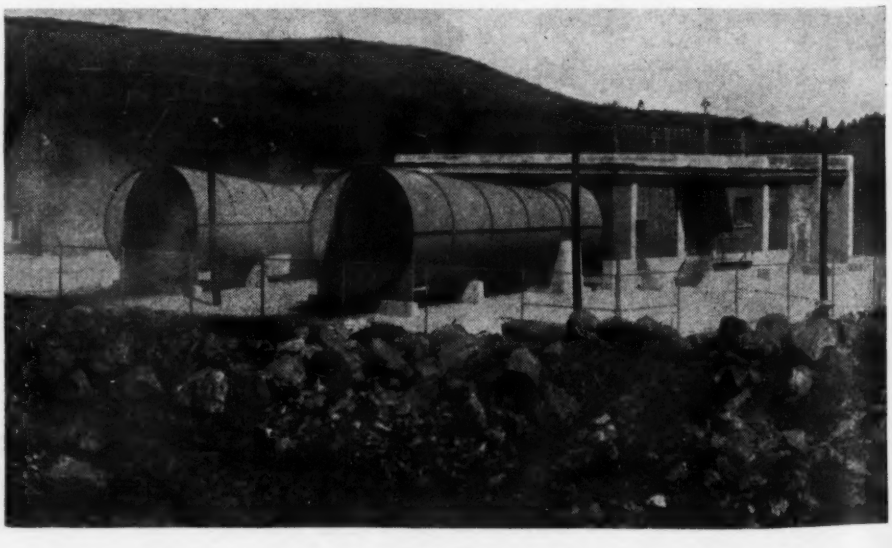
The hotel buys all service through a single meter since this gives the customer the most advantageous rate. Maximum demand for all service is 354 kw. Electric cooking worked out very economically for the hotel since load factor was greatly improved, enabling the customer to earn a much better rate for general service and a very attractive rate on the new electric kitchen.

Equipment is of the Edison heavy-duty type sold by Dohrmann Hotel Supply Co. of Portland. M. L. Glenn and D. O. Bergey handled all negotiations for Northwestern Electric Co., the serving utility.

Power Requirements of Hoosac Tunnel Ventilation

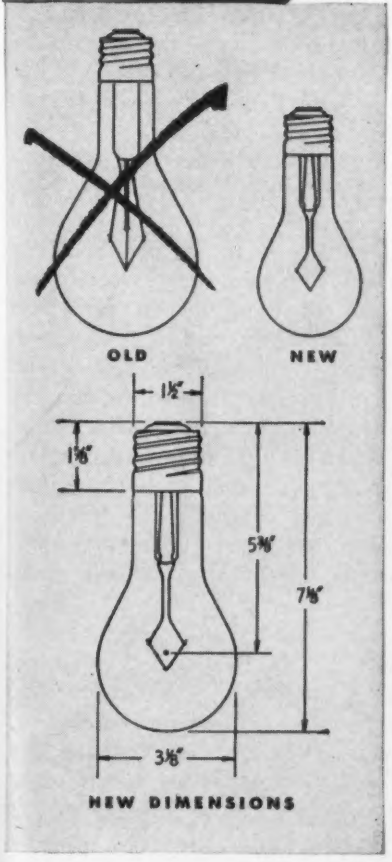
INSTALLATION of new and greatly improved ventilating equipment to clear the Hoosac Tunnel of the Boston & Maine Railroad of gases still provides a desirable load for the Northern Berkshire Gas Co., a New England Power System subsidiary with headquarters at North Adams, Mass. Completed in 1875 at a cost of about $14,000,000, this tunnel, 4.75 miles long, is still one of the most famous in the world. It was excavated to a height of 20 ft. and a width of 24 ft., and for some years was ventilated by natural draft through a central shaft 1,028 ft. deep and 15 ft. by 27 ft. in horizontal dimensions. For about 50 years a motor-driven, paddle-wheel type of fan handled the ventilation. This early

EXTERIOR of new fan house on top of Florida Mountain, at outlet of central ventilating shaft of 4.75-mile tunnel. Gases drawn from the tunnel by natural ventilation through a 1,028-ft. shaft and by modern motor-driven fans are discharged into the atmosphere by the two tapered ducts shown, motors being remotely controlled through carrier equipment and switching facilities located in the fan house and at a railroad signal tower four miles down the mountain



Now you can standardize on the new G-E 2500 lumen street lamps!

Adapted to old Luminaires where lamps of 2500 lumen or less now are used, and to new Low-Cost Equipment of superior efficiency



FOUR new, more compact 2500 lumen street lamps are now available from General Electric, offering several important advantages:

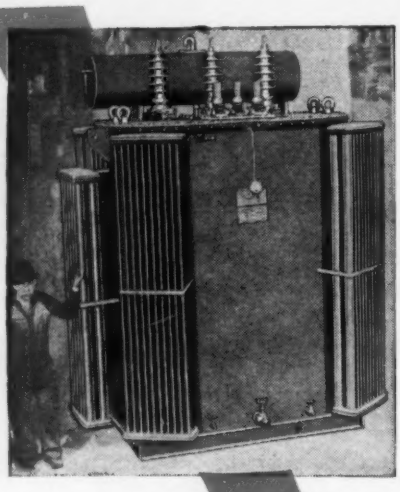
Smaller lamp dimensions. Light center length reduced from 7″ to 5⅜″; over-all length from 9⅜″ to 7⅛″.

Improved, low-cost lighting. The new lamps have enabled manufacturers to develop luminaires that are smaller, less expensive, yet more effective in utilizing the light for safe seeing.

Interchangeability with lamps of lower rating. Greatly facilitate standardization. Can be used without socket adjustment in luminaires designed for 1000 lumen and smaller lamps.

Protection against arcing. They embody close-lead construction as an additional safeguard against service difficulties from arcing.

Available in current ratings of 6.6 and 7.5 amperes, and in standard 2000-hour and group replacement 3000-hour life ratings. For full details, call your nearby G-E lamp office.



POWER TRANSFORMERS
BY
UPTEGRAFF

Uptegraff Power Transformer, Type O. I. S. C., 1500 KVA, 60 cycle, 33,000 volts star-connected to 480 volts delta-connected.

"Uptegraff" is a name for Quality and Service in Power Transformers.

Designed by an Engineering force and constructed in a plant devoted exclusively to manufacturing Transformers, every Uptegraff Transformer is built to deliver power continuously and without interruption at its full rated capacity.

Our organization is equipped to satisfy your individual requirements, and our plant is prepared to handle your production needs.

All Uptegraff Transformers comply fully with the standards of NEMA, AIEE and ASA.

For Quality and Service allow us to quote on your Power Transformer needs, and ask for Bulletin No. 111

R. E. UPTEGRAFF
Manufacturing Co.
NEMA MEMBER
SCOTTDALE
PENNA · USA

arrangement consumed an average of 89,392 kw.-hr. per month (January to May, incl., 1945), to 102,180 kw.-hr. per month (January to May, incl., 1944).

The tunnel was electrified in 1911 with single-phase locomotive operation. During the last few years the railroad has been gradually equipping the Fitchburg division with Diesel-electric locomotives, and it is expected that all train service through the tunnel will therefore be thus powered in the near future.

New Fan System

Ventilation requirements and the aging of the initial fan equipment led to the installation late in the summer of 1945 of a complete new fan system. This consists essentially of two Westinghouse 50-100-hp., 440-volt, 3-phase motors designed to operate at either 391 or 589 rpm., each direct-connected to a Jeffrey propellor type "Aerodyne" fan 8 ft. in diameter, with eight plastic blades per fan and a variable pitch adjustable for seven angles. Westinghouse supervisory control operates from a railroad switching tower at North Adams, 4 miles down the mountain, with carrier telephone facilities and 6,600-volt supply line to the fan house at the summit of the mountain through which the tunnel runs. Remote indications are given at the tower in case of any electrical or mechanical disturbance at the fan station, which requires periodic inspection but no fixed attendance. In case of overheated bearings, the motors stop instantly and the fan speeds are controllable both at the fan house and from the signal tower. Miners and track walkers in the tunnel report by telephone any atmospheric conditions requiring changing the fan speed, and operating times depend on train schedules, humidity within the tunnel, and other conditions. The air within the tunnel can be completely changed in 25 minutes by operating both fans together at high speed, or in 35 minutes at low speed. Normally low-speed operation is used, running both fans, with increased electrical efficiency over higher-speed service.

The installation was made under the direction of D. M. Burckett, electrical engineer for the railroad's engineering department.

The increased efficiency of the new fans and driving motors is shown by the operating record for January to May, incl., 1946, compared with the

These New Guth HY-LITERS

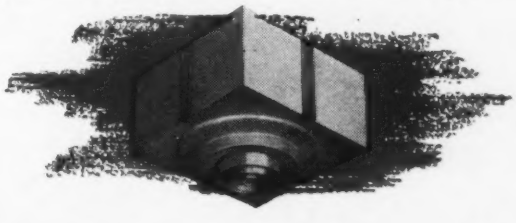
DRAMATIZE MERCHANDISE!

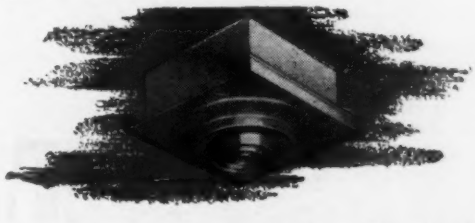
INTENSE SPOT-LIGHT AND FLOOD-LIGHT EFFECTS WORK MIRACLES WITH STORE DISPLAYS!..

GUTH HY-LITERS, using 150-watt Sealed Beam Projector Lamps, provide novel, effective "accent" lighting for stores! HY-LITERS, easily adjustable through a 90° arc for full concentration on merchandise displays or in show windows, bring dramatic emphasis to modern retail merchandising.

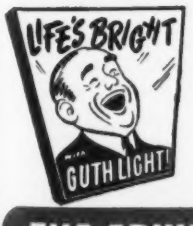
HY-LITERS' exterior portions are finished lustrous 300° WHITE Enamel, and surface types are attractively trimmed with polished Aluminum flutings.

They're beautifully fashioned—the last touch in good store lighting. Write today for more details.





Two Types Available for ACCENT Lighting!

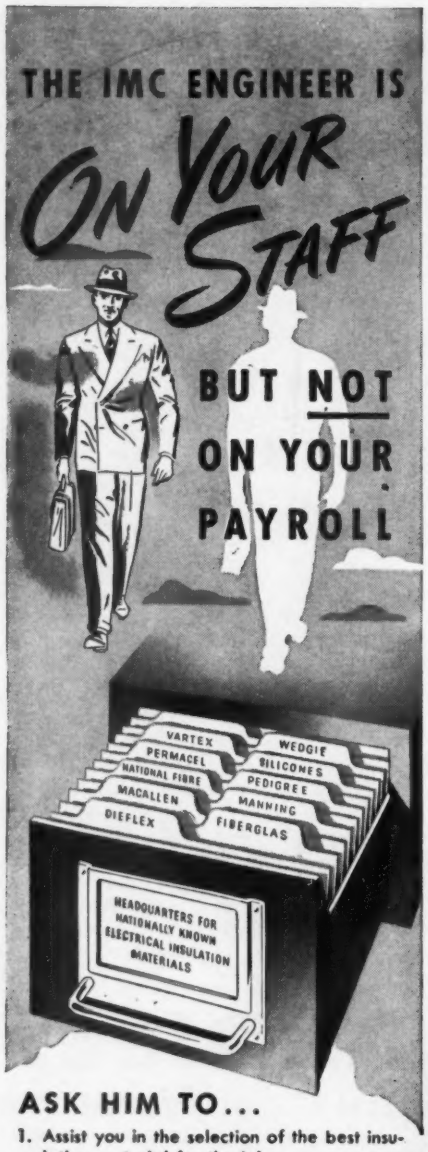


HY-LITERS may be had for either Surface or Recessed Mounting. Both types are suitable for use as individual units, or arranged in rows with GUTH FLUORESCENTS. HY-LITERS maintain the high engineering and construction standards of all GUTH Lighting Equipment, and are ideal for today's important ACCENT Lighting.

GUTH HY-LITERS *ARE AVAILABLE NOW!*

THE EDWIN F. GUTH CO. • 2615 WASHINGTON AVE • ST. LOUIS 3, MO.

Guth *Leaders in* LIGHTING SINCE 1902



ASK HIM TO...

1. Assist you in the selection of the best insulating material for the job.
2. Familiarize you with their proper application.
3. Suggest ways to eliminate waste.
4. Increase your production.

The IMC engineer makes his recommendations on the basis of his knowledge and experience—not of one or a few electrical insulating materials but of many. He and the IMC organization are at your service to give technical assistance as well as to see you get what you need when you need it.

INSULATION MANUFACTURERS CORPORATION

ELECTRICAL IMC INSULATION

CHICAGO 6, 565 W. Washington Blvd.
CLEVELAND 14, 1231 Superior Ave., N. E.

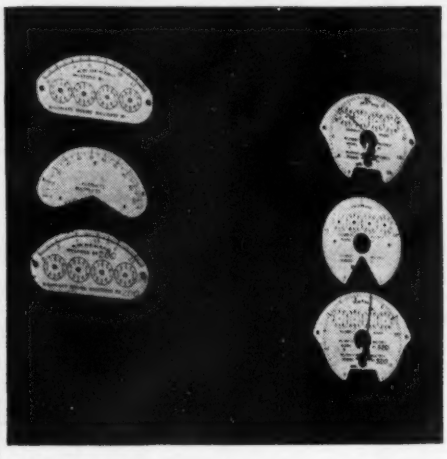
BRANCHES in MILWAUKEE 2, 312 East Wisconsin Ave., DETROIT 2, 11341 Woodward Ave., MINNEAPOLIS 3, 1208 Harmon Pl., PEORIA 5, 101 Heinz Court, and other cities

same periods in 1944 and 1945. The average energy consumption per month dropped to 17,488 kw.-hr. for the first five months of this year, compared with 89,392 kw.-hr. for the 1945 period and 102,180 kw.-hr. for the 1944 period. The demand in kilowatts ran from 182.4 kw. to 192 kw. in the 1946 term cited; from 163.2 to 172.8 kw. in the 1944 period named, and from 158.4 kw. to 172.8 kw. in 1944, January to May. The load includes fan station lighting, battery charging facilities, and communication equipment, with control apparatus, in addition to the fan drives. Electric heaters are also installed to maintain satisfactory temperature conditions within the fan house and control cabinet rooms on the mountain.

•

To Reduce Demand Reading Errors

DIFFERENCES in register faces and scales between various makes and types of demand meters may cause errors in readings if meter readers are not familiar with all of them. Reduction of this possibility of error was the subject of an employee suggestion received by the Pacific Gas & Electric Co. from T. M. Crowley of its San Francisco division. The suggestion was to mount all the different types of demand register faces on a display board for study by meter readers in training. The board, a portion of which appears in the accompanying illustration, and which now holds ten register faces and scales, with some half dozen more to be added when they are obtainable, has already demonstrated its effectiveness.

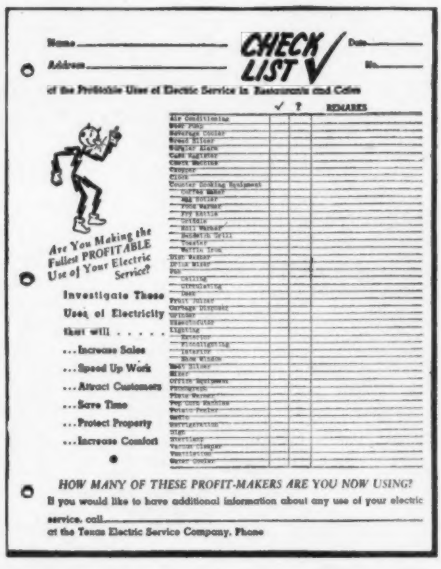


DEMAND METER registers on a display board familiarize meter readers with different types

Service Check Lists For Commercial Customers

TO HELP its commercial representatives bring before store owners of Fort Worth the myriad uses of electric service that will increase sales, speed up work, attract customers, save time and increase comfort, Texas Electric Service Co. has developed a series of electric service check lists, one of which is illustrated.

In addition to reminding the customer of many unthought-of applications of service in his place of business the list provides the company's representative with information on customers' existing equipment and those for which he is a prospect.


Name _____ Date _____
Address _____ Rt. _____

CHECK LIST

of the Profitable Uses of Electric Service in Restaurants and Cafes

Are You Making the Fullest PROFITABLE Use of Your Electric Service?

Investigate These Uses of Electricity that will . . . . .
...Increase Sales
...Speed Up Work
...Attract Customers
...Save Time
...Protect Property
...Increase Comfort

✓ ? REMARKS

Air Conditioning
Beverage Cooler
Bread Slicer
Computer Scale
Cash Register
Check Writer
Coffee Mill
Coffee Urn
Counter Cooking Equipment
Coffee Maker
Egg Cooker
Food Warmer
Fry Kettle
Griddle
Hash Warmer
Sandwich Grill
Toaster
Waffle Iron
Dish Washer
Disposall
Dough Kneader
Drink Mixer
Egg Beater
Food Chopper
Ice Cream Machine
Meat Grinder
Meat Tenderizer
Mixer
Office Equipment
Refrigerator
Time Recorder
Vacuum Cleaner
Water Cooler
Refrigeration
Sign
Steriliser
Vacuum Cleaner
Ventilation
Water Cooler

HOW MANY OF THESE PROFIT-MAKERS ARE YOU NOW USING?

If you would like to have additional information about any use of your electric service, call _____ at the Texas Electric Service Company. Phone _____

CHECK LIST—As a reminder to its commercial customers of the many profit-making uses of electric service available to them, Texas Electric Service uses a series of check lists covering applications in various classes of business establishments. Shown above is the list of applications for restaurants and cafes

Check lists being used by the Fort Worth company cover (1) restaurants and cafes, (2) physicians' offices, (3) beauty and barber shops, (4) hardware and variety stores, (5) drug stores, (6) filling stations and garages, (7) grocery and food stores, (8) department stores and others.

These lists have been used so successfully in the past that they are being revised and will be among the tools available to the company's representatives for developing commercial load in the future.

Design Possibilities... UNLIMITED

WITH PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT

MODERN LIGHTING CONCEPTS combine beauty, utility and efficiency. When you put these concepts into practice you can see why *Pittsburgh Permaflector* Lighting Equipment becomes the logical choice for new building and modernization programs. This equipment gives you beauty, utility and efficiency—plus unusual flexibility of application.

PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT can be easily incorporated into your designs and plans. The full line of fluorescent and incandescent units meet every application requirement—interior and exterior . . . commercial, institutional and industrial.

YOU ACHIEVE LIGHT MODERNIZATION AT ITS FINEST when you specify *Pittsburgh Permaflector* Fluorescent and Incandescent Equipment . . . equipment which is distinctively styled, simple to install and provides maximum performance with minimum maintenance. Check with your nearest *Permaflector* Lighting Engineer or electrical wholesaler . . . or write direct for full data.

ADRIAN DRESS SHOP

Designer: G. Reed Agnew
Elect. Contr.: Wood Elect. Construction Co.

Pittsburgh Permaflector

PITTSBURGH Reflector Company

OLIVER BUILDING, PITTSBURGH 22, PA.

MANUFACTURERS OF FLUORESCENT AND INCANDESCENT LIGHTING EQUIPMENT

Permaflector Lighting Engineers in All Principal Cities

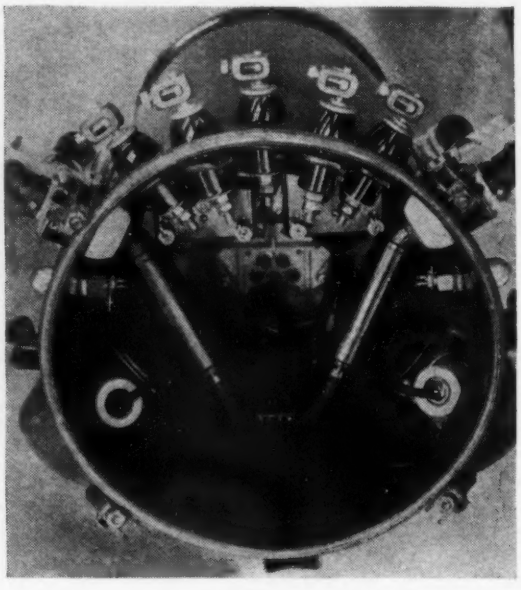
Something Better Has Come to Light!

PERMAFLECTORS · SPOTLIGHTS · FLOODLIGHTS
FLUORESCENT EQUIPMENT · WIRING DEVICES

Distributed By Better Electrical Wholesalers

NEW EQUIPMENT

New Transformer Developed for Secondary Banking



A NEW TRANSFORMER (CSPB) designed especially for banked secondary service has been announced by Westinghouse Electric Corp., Pittsburgh 30, Pa. Core and coil of the new transformer are identical with the CSP. However, two double-pole circuit breakers (CSP has one) are mounted side by side on the top frame of the core. Each breaker feeds one of the two secondary circuits from the transformer.

To provide the necessary secondary connections, five secondary bushings are furnished for supplying the two 3-wire circuits. The neutral bushing is common to both circuits. Protective links are connected in series with the high-voltage winding to disconnect the unit in case of internal fault.

The new transformers in a banked system are reported to reduce light flicker resulting from appliance motor load, reduce necessary installed capacity, and to eliminate such troubles as cascading, or reversion to radial operation.

They are now available in 10- and 15-kva. sizes in standard high-voltage ratings from 2,400 to 14,400 volts inclusive. The 10-kva. size weighs 339 lb. and the 15 is listed as 434 lb. Units down to 5 kva. in size and up to 37½ kva. will be available in the near future.

Transformers of this type may be installed using either a closed-loop secondary or a straight-run type of secondary. The usual installation practice is to mount the secondary conductors on racks. The secondary neutral is continuous throughout its length but insulators are inserted in secondary "hot" lines close to each transformer pole. Connections at the transformer are simplified by energizing one section of the secondary from the two right-hand bushings and the other section from the two left-hand bushings. The center bushing is the common neutral.

Field experience with this transformer is reported in detail in ELECTRICAL WORLD, March 2, 1946, page 56.

•

Furnace Temperature Control Anticipates Heat Needs

A NEW Electronic Balancer Input Controller used to provide temperature control for industrial electrical furnaces is being announced by Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia 44, Pa. The established principle of using timed impulses of current to heating elements is combined with an electronic circuit which detects and corrects for the deviations in temperature from any preset point.

The proportioning of the on-time to off-time is accomplished in exact relation to the amount and direction of temperature drift, the manufacturer states, and the heat input will automatically adjust to heat demand.

Basically, the principle relies on a Wheatstone bridge circuit which exists between one slide-wire in a pynometer and another in the Input Controller. Unbalance in this slide-wire circuit, caused by variation of temperature from preset position, regulates the time period that the heating elements are energized.

Whenever the temperature is low and outside the pynometer throttling range (a band on the scale 5 percent above and below the preset temperature), as in the case when heating up a cold furnace or when a fresh charge has been added to the furnace, power is on 100 percent of the time. As the temperature comes within the throttling range, the heating circuit is alternately opened and closed so that heat is delivered as rapidly as possible for absorption by the charge without incurring overshoot.

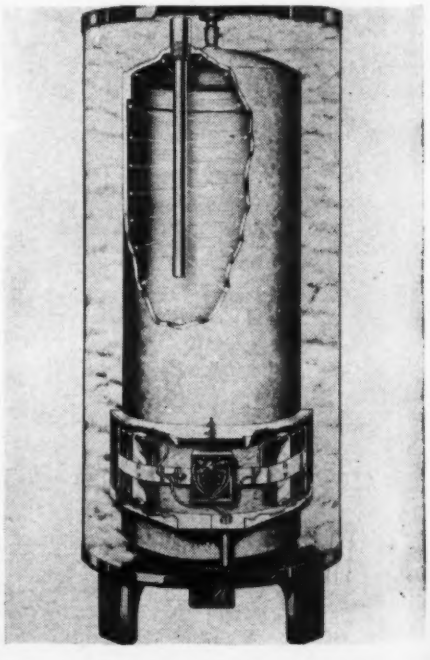
•

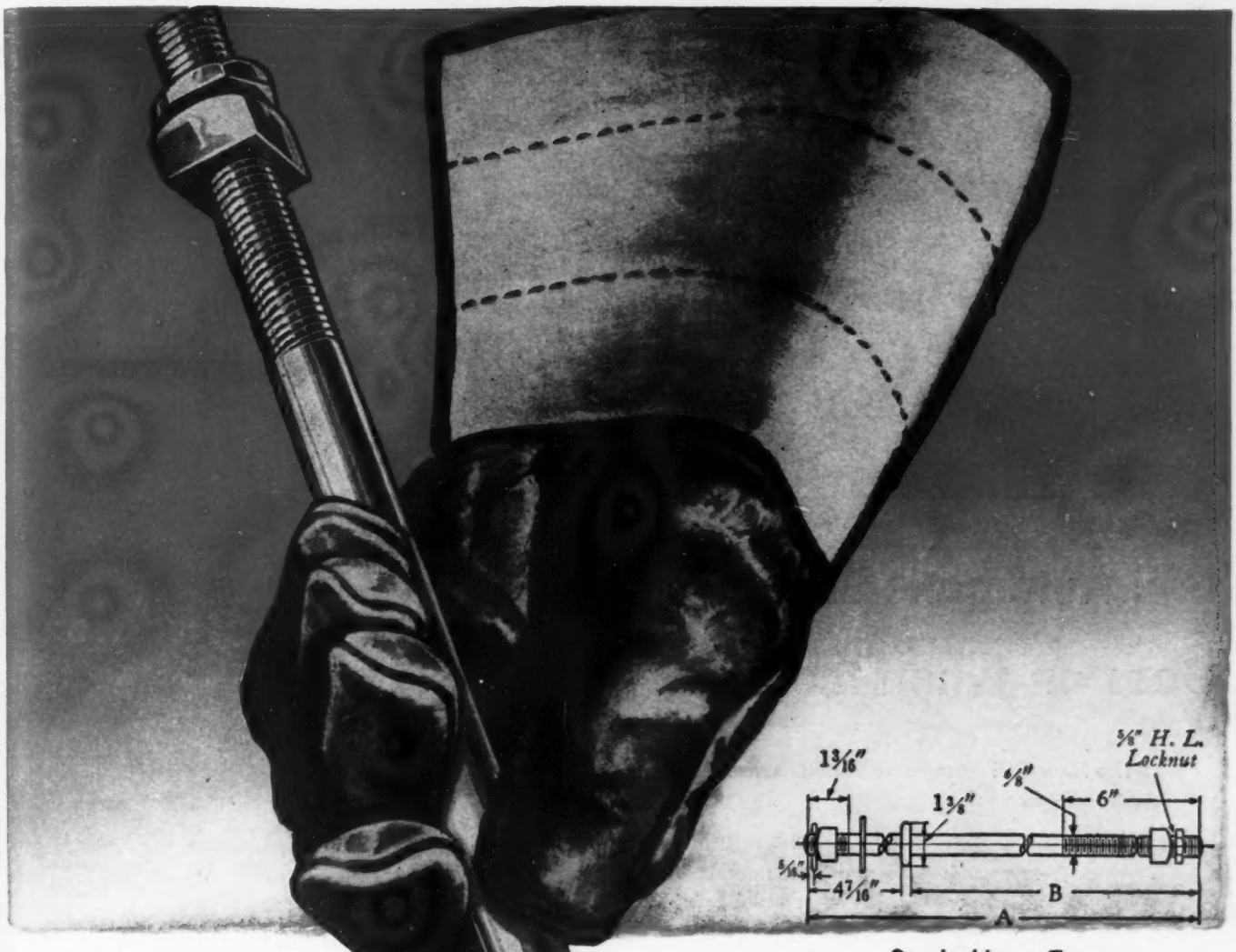
Water Tank Corrosion Cut by Magnesium

A NEW SERIES of electric water heaters is being introduced by the Clark water heater division, McGraw Electric Co., 5201 West 65th St., Chicago 38, Ill. It differs from previous models in that protection against corrosion is provided by a 24-in. magnesium rod placed inside the water tank, as is shown in the accompanying illustration.

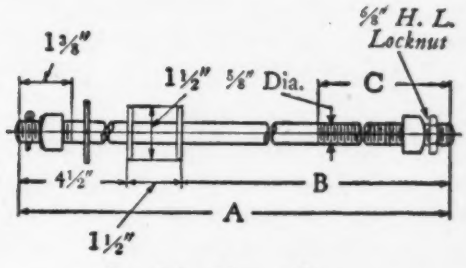
Magnesium, being the more active of the two metals in contact with the water, becomes the anode and iron, the tank, becomes the cathode. The flow of current, being from the anode to the cathode, "eats" the magnesium rod rather than the tank and thereby provides tank protection.

To limit the amount of current flowing only to that which is necessary, and thereby to lengthen the life of the magnesium rod,





Single Upset Type



Double Upset Type

Hubbard Insulator Bolts

SINGLE AND DOUBLE UPSET TYPES HOT GALVANIZED

*SINGLE UPSET TYPE

Stock No.	DIMENSIONS—INCHES A	B	Thread Dia.	For Use With Insulator No. (Not Included)	Approx. Shipping Wt. Lbs., 100 Pcs.
8740	11¾	7	⅝	455 or 355	170
8741	12¾	8	⅝	455 or 355	180
8741½	13¾	9	⅝	455 or 355	189
8742	14¾	10	⅝	455 or 355	197

*DOUBLE UPSET TYPE

Stock No.	DIMENSIONS—INCHES A	B	C	Thread Dia.	For Use With Insulator No. (Not Included)	Approx. Shipping Wt. Lbs., 100 Pcs.
8824	13	7	3½	⅝	455 or 355	179
8826	14	8	4½	⅝	455 or 355	188
8828	15	9	5½	⅝	455 or 355	196
8830	16	10	5½	⅝	455 or 355	204

*All sizes listed are Rural Standards

Other types and sizes of Single and Double Upset Bolts can be supplied on special order but are not carried in stock.

HUBBARD and COMPANY

PITTSBURGH • CHICAGO • OAKLAND, CAL.

G-E Automatic Blanket—
Goes *on* when the lights go *off!*

The New G-E Automatic Blanket makes even the darkest hours pay off—for you!

Here's a load-builder that goes to work just when you need it most—from *midnight till morning.* Thousands of G-E Blankets now in use—and *every two* equals one six-foot refrigerator in kilowatt-hour consumption.

More good news coming up! Soon G-E's exclusive Two-Control Blanket will be available, in addition to the One-Control Blanket. New sleeping comfort for husbands and wives requiring separate degrees of sleep-inducing warmth! More off-peak load for you!

For almost two years your customers have been reading about G-E Blankets in top-circulation magazines like *Life, Good Housekeeping, House Beautiful, This Week,* and *National Geographic.* And from coast to coast they're hearing about war-improved G-E Blankets —via the zippy radio show, "The G-E House Party" over C. B. S.

So, Write Now for complete information. Find out how you can make the most of this new load-builder. Appliance and Merchandise Dept., General Electric Company, Bridgeport 2, Connecticut.

First in sleeping comfort

Automatic Blanket

Approved by Underwriters' Laboratories, Inc.

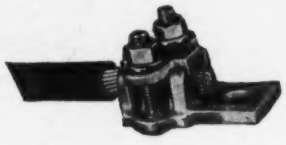
GENERAL ELECTRIC

a resistance is inserted between the tank and the rod. As in previous designs, the "life-belt" type of heating element is employed so that dissimilar metals are not present in the tank.

•

New Variable Lug Utilizes Twin Type Bolts

A NEW variable bolt-type lug, which is made in six sizes for accommodating conductors from No. 1 stranded up to 1,000,000 cir.



mil, is being announced by Dossert Mfg. Co., 249 Huron St., Brooklyn 22, N. Y. They are made of a high copper alloy and made up of four components.

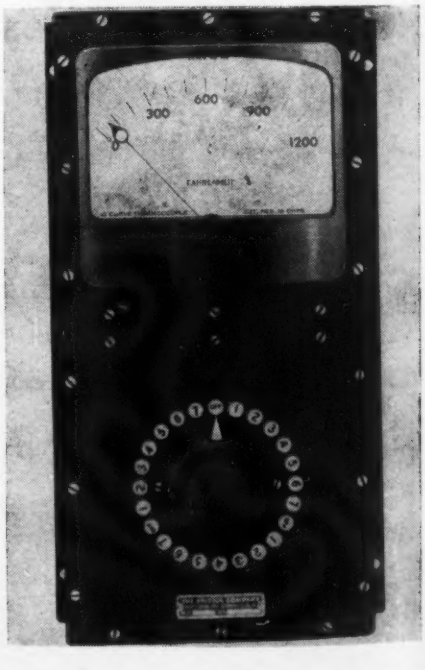
The conductor is gripped between the main body and the saddle by tightening the two Everdur nuts and bolts. Both conductor bearing surfaces are serrated to break through oxidized surfaces on the conductor. Bolt holes are recessed to prevent bolts from turning and the bolt threads are turned over to prevent the nut from becoming disengaged. Bolts may also be inverted when space conditions make this necessary.

Hole in the contact pad can be drilled to customers' specifications. Preliminary heat run and vibration tests have been run and proven satisfactory.

•

Diesel Engine Pyrometer Serves Up to 24 Cylinders

A NEW diesel engine pyrometer (model 6-426), with a millivoltmeter type of movement which is damped to resist vibration, has been announced by the Bristol Co.,



More answers to your questions about

Certified Ballasts

BUY CERTIFIED BALLASTS, because . . .

1. Certified Ballasts are built to exacting specifications.
2. They're tested, checked and *Certified* as meeting those specifications by famous Electrical Testing Laboratories, Inc.
3. Leading fluorescent tube makers will guarantee lamp performance when Certified Ballasts are specified in fixture.
4. You get good lamp performance, good fixture operation and minimum service worries, when you use Certified Ballasts.

Why *Certified* Ballasts are better

Q. ***How does a Certified Ballast assure good lamp performance?***

A. In all technical characteristics, Certified Ballasts are built to perform a balanced operation with the lamps for which they are designed. All of the features listed below have a definite influence on good lamp performance.

Q. ***What about noise?***

A. Certified Ballasts are quiet in operation. Ballast hum is also dependent on proper installation . . . such as in Certified Fleur-O-Lier and RLM fixtures.

Q. ***What about long life?***

A. Certified Ballasts, properly installed, will normally outlast the entire lighting installation itself.

Q. ***What about heating?***

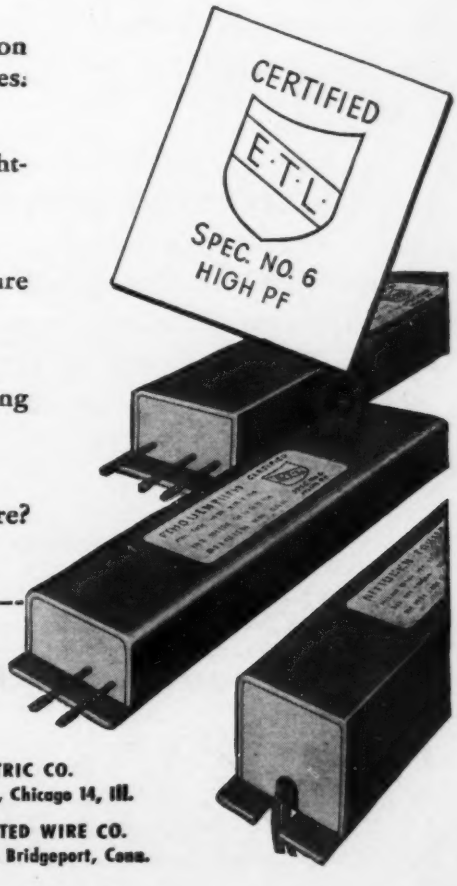
A. Certified Ballast specifications guard against any dangerous temperature rise which might affect operation.

Q. ***What about uniform quality?***

A. Latest manufacturing methods, plus rigid testing by Electrical Testing Laboratories, Inc., assure and guard uniform high quality.

Q. ***What about cost?***

A. Certified Ballasts *cost no more* than any other ballasts. So why not be sure? Look for the ETL Certification mark on the equipment you specify.



Certified Ballast Manufacturers

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

THE ACME ELECTRIC & MFG. CO.
Cuba, New York

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation
3501 Addison St., Chicago, Illinois

GENERAL ELECTRIC CO.
Speciality Transformer Division
Fort Wayne, Ind.

JEFFERSON ELECTRIC CO.
Bellwood, Illinois

SOLA ELECTRIC CO.
2525 Clybourn Ave., Chicago 14, Ill.

WHEELER INSULATED WIRE CO.
378 Washington Ave., Bridgeport, Conn.

WHAT TYPE SCHRAMM AIR COMPRESSOR DO YOU NEED

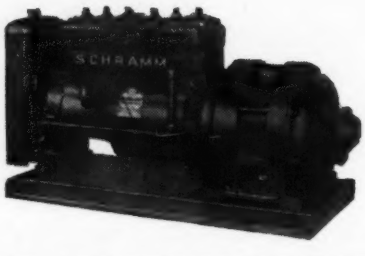
Do You Need **DIRECT DRIVE ON BASE?**

Built-in Motor Drive mounted on steel base is compact and easy to install. No foundations necessary.

Do You Need

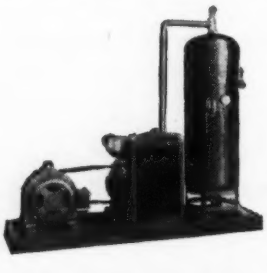
DIRECT MOTOR DRIVE WITH COOLING UNIT?

Schramm 300 cu. ft. displacement with direct-connected 50 H.P. motor with cooling unit on Steel Deck Base.



Or— **BELT DRIVE WITH TANK AND COOLING UNIT**

mounted and ready for immediate installation? Belt Drive complete with motor, vertical air receiver and cooling unit all mounted on a single base.



SCHRAMM offers you a complete line of Air Compressors for your every need! Sizes range up to 600 cu. ft. displacement! Schramm's stationary units are widely used in plants throughout the country, and are specified because they are vibrationless, lightweight, compact . . . and at the same time easily furnish a steady flow of air. Write today for full details on Schramm Air Compressors.

SCHRAMM INC

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

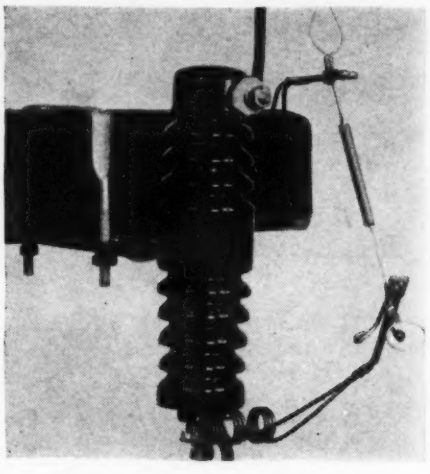
Waterbury 91, Conn. It is provided with a 24-point switch and universal dial which allows it to be adapted to various combinations of engines and numbers of cylinders. Thermocouple for installation in nearly all types of engines are available.

•

Flip-Open Fuse Cutout Has Bird-Proof Construction

AN IMPROVED design of the flip-open fuse cutout embodying "bird-proof" construction in 50-ampere, 7500- and 15,000-volt ratings, has been announced by the General Electric Co., Schenectady 5, N. Y.

The new cutouts have a solid, streamlined,

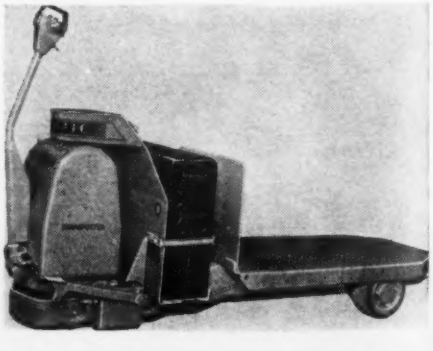


porcelain insulator with the mounting support and the upper and lower contact supports cemented into the porcelain so that the live parts are confined to the side of the insulator opposite the mounting bracket. The cutout may be mounted vertical, angle tilted, or swiveled to any desired position; either in separate mounting, or in combination crossarm mounting or T-bracket pole mounting with an arrester.

•

Electric Battery Truck Has Two Pressure Cylinders

TRANSPORTER, a new electric battery propelled hand truck, with a new type hydraulic lift pump that has low-pressure, high-speed cylinder for bringing the platform in contact with the load and a high-speed, low-pressure cylinder for lifting the load, is a recent development of the Automatic Transportation Co., 149 West 87th St., Chicago 20,



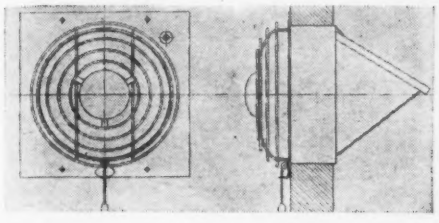
Ill. Another feature reported is the reduction of the number of strokes necessary to start rolling.

It is made in four models: 4,000- and 6,000-lb. capacity platform types for skid platforms; 4,000-lb. capacity for type for pallet loads; and a 3,000-lb. capacity fork model for tin plate.

•

Ventilating Fan Designed For Use With Thin Walls

A NEW "Ilgvent 8 Package Type" ventilating fan for use in thin wall construction has been announced by Ilg Electric Ventilating



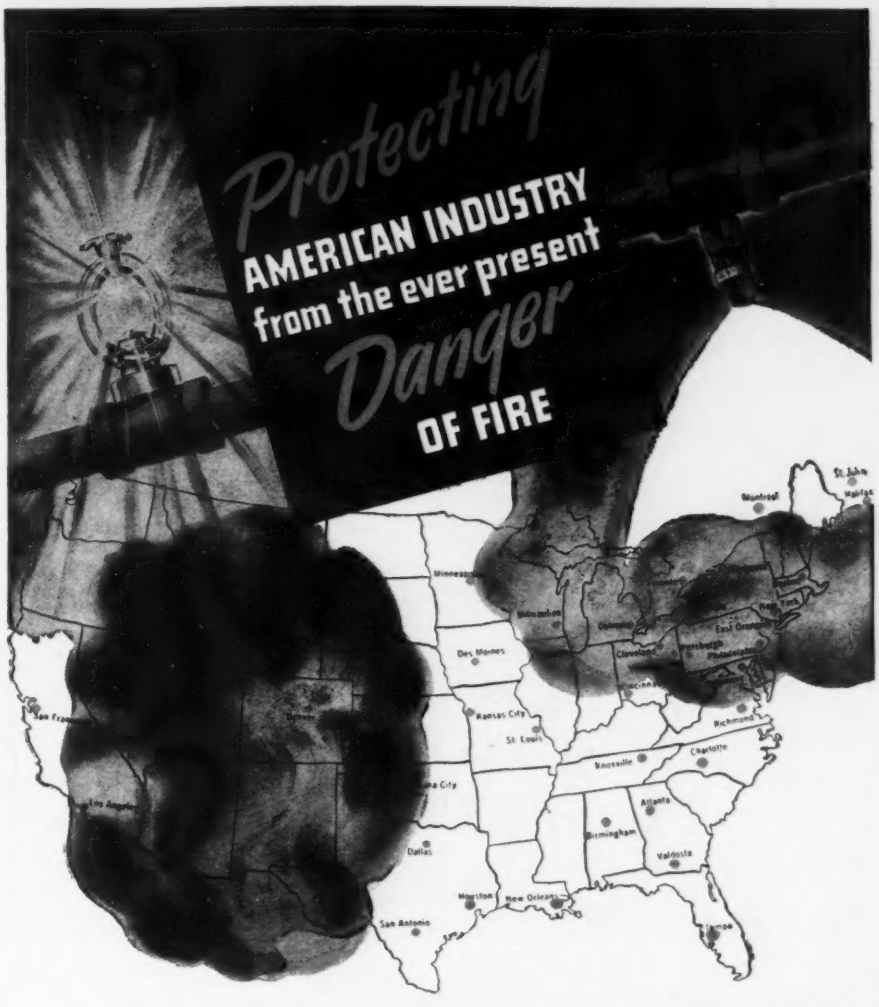
Co., Chicago, Ill. It is available with 3¾-in. sleeve for mounting in the walls and is also suitable for installation in a steel sash or other small panel window, with the unit replacing one pane of glass.

Electrical connections can be made from a circuit in the wall or with an extension cord to a nearby electrical outlet. Beaded pull chain is used to open or close the weather-tight outer door, simultaneously starting or stopping operation of the fan. The fan has a capacity of 350 cfm.

•

Frequency Meter Range From 1.5 to 100 Mc.

FREQUENCY METER (model S-4) to cover specified frequencies in the range from 1.5 to 100 mc. has been developed by Browning



The map above locates the many "Automatic" Sprinkler offices. There are 37 of them, in an area extending from coast to coast and from Texas to Canada. These offices are manned by a staff of thoroughly qualified fire protection engineers, men who are familiar with all types of fire hazards and the various systems best suited for protection. They'll be glad to show you how to safeguard your plant, equipment and production from the ever present danger of fire.

Our new Bulletin No. 56 explains in detail the operation of the various "Automatic" Sprinkler systems. Write for your copy today . . . it's free. Use the coupon.

MAIL THIS

"Automatic" Sprinkler Corporation of America
P. O. Box 360 Youngstown 1, Ohio

Please send me a copy of your Bulletin No. 56, which contains descriptions of modern fire protection systems.

Name.....
Company.....
Title.....
Address.....
City..... State.....

"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 37 CITIES

"Automatic" Sprinkler designs, manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories

FORD TRUCKS LAST LONGER!

THE AGE OF ALL FORD TRUCKS IN USE TOTALS 12½ MILLION YEARS!

Ford

Laboratories, Inc., Winchester, Mass. The meter may be used in checking frequencies of AM and FM transmitters and is stated to have an accuracy of 0.0025 percent.

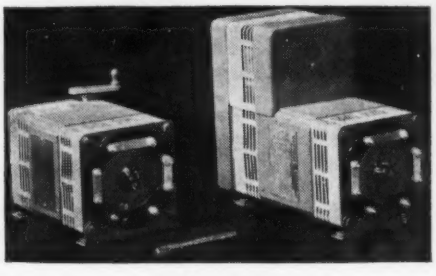
A 100-kc. crystal is used as a secondary standard. Its frequency may be checked against WWV, assuring an accuracy of 5 cycles in 10,000,000. Checks of the crystals against the ECO may be obtained by means of a cathode ray indicator and are said to be within 1 part in 1,000,000.

A machine cut dial with vernier is employed for tuning the ECO. As noted from the accompanying illustration, a telescoping antenna is used for coupling to the transmitter.

•

600-V. Induction Regulator Available in Dry Type

A LINE of dry-type induction regulators to include 300- and 600-volt-ampere ratings has been announced by the General Electric Co., Schenectady, N. Y. The units originally



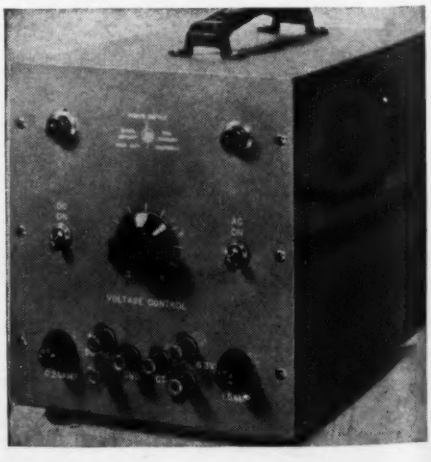
were developed for use in communication equipment and are now available in hand- and motor-operated models for use in motor speed control, heat control of electric furnaces, illumination and rectifier control, dielectric testing and instrument calibrating.

Units are designed for continuous operation with a temperature rise not to exceed 55 deg. C. and to operate at autotransformer efficiency.

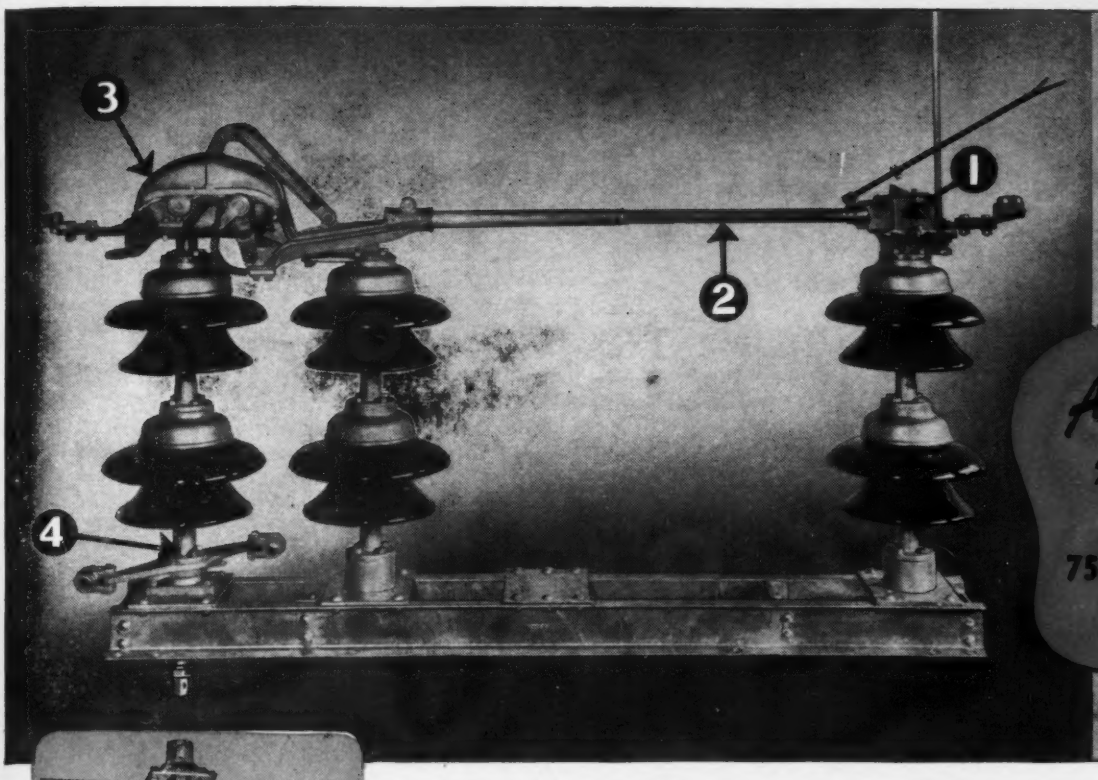
•

Power Pack Regulates Between 180 and 360 Volts

POWER SUPPLY, which will produce a regulated voltage for laboratory or production, has been developed by Hewlett-Packard Co., Palo Alto, Calif. Output is continuously



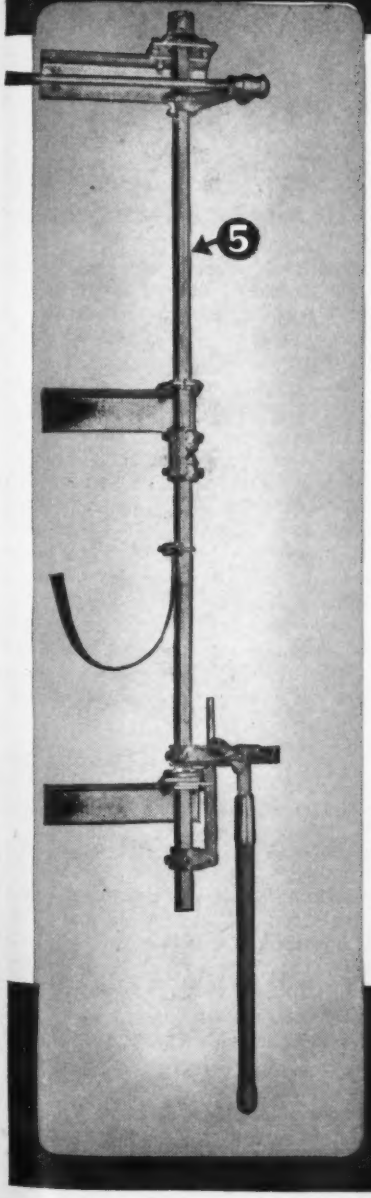
They're the LINEMEN'S PRIDE!
BLACKBURN Service Entrance CONNECTORS
"WE LIKE TO USE EM"
THE circular construction of BLACKBURN Service Entrance Connectors gives extra strength along the line of pull of the screw. Also, these are the only service entrance connectors made of DURONZE—75% stronger than hard copper or commercial bronze. That is why BLACKBURN Connectors won't stretch or distort; won't come loose. Linemen invariably choose BLACKBURN—because they're better . . . It pays to use a QUALITY product!
Over 100 Conveniently-Located Jobbers' Stocks
JASPER BLACKBURN PRODUCTS CORP.
First, Madison & Clinton Sts., St. Louis 6, Mo.
Builders of Quality Connectors for Over 10 Years



Available

200 TO 3000 AMPERES

7500 TO 287,000 VOLTS



FOR "CERTAIN" OPERATION

Anytime . . . under any Condition

specify HI-VOLTAGE

A Hi-Voltage Switch may stay idle for years, but when it is called upon to perform, it operates without any hesitancy. Every user will testify to this "certain" operation. Reasons why are:

1. ***Contact housing*** not only protects the contacts, but also acts as an ice breaker.
2. ***Straight push-pull*** close-open action of switch arm assures most positive opening and closing of switch.
3. ***Completely housed*** operating mechanism with corrosion-proof parts cannot bind or stick. Requires no lubrication . . . never needs adjustment.
4. ***Monel ball bearings*** in stainless steel races, never requiring any lubrication, guarantee that the bearings are ready to operate anytime . . . under any condition.
5. ***Completely machined*** operating shafting adds a definite degree of accuracy and certainty to the switch action.

No field drilling or cutting of parts is required with Hi-Voltage Switches. Their simplicity and ease of installation remove any possibility of improper installation. Time is saved, "certain" operation is assured. Work done at the factory saves hours for the construction crew. After all . . .

IT'S THE INSTALLED COST THAT COUNTS

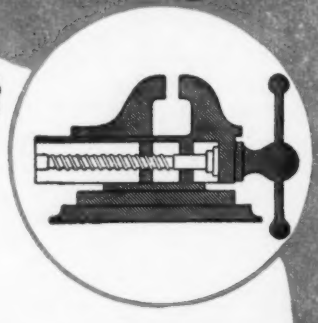
Recommendations and complete drawings for any installation will be submitted without obligation. Just send a sketch of the substation outline, the proposed location of the switch and the desired location of the operating shaft.

HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79th STREET • CLEVELAND 4, OHIO

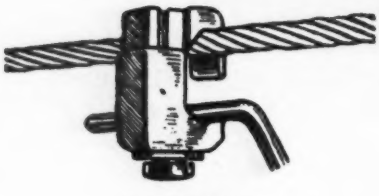
FARGO connectors go on FAST... and stay on tight

because they are built like a vise... grip like a vise!



Hook on Run

1 One piece construction — one bolt to tighten—always threaded — no time lost starting a nut — no chance of cross threading — no loose parts to lose.



Insert Tap

2 The bolt, specially forged and rolled for extra strength, turns easily and develops 10 lbs. or more compression between conductors for every inch-pound of wrench pressure.

Tighten Bolt

3 This high pressure at wire contact working with inside thrust action against the vise-type sleeve of the connector results in the vibration-proof bind of the Fargo connector.

There are 12 sizes of Fargo Solderless Connectors for wires from No. 8 solid to 1000MCM.

•

Full Fargo Line Distributed by

LINE MATERIAL COMPANY, MILWAUKEE, WISCONSIN

(Representatives in principal cities)

FARGO *ESTABLISHED 1914*

MFG. COMPANY, INC.

Poughkeepsie, N. Y.

LM

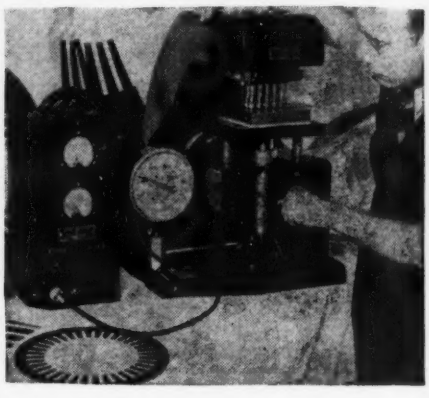
variable between 180 to 360 volts, and is stated to remain constant to within 1 percent for loads up to 75 ma., and for line variations of plus or minus 10 percent.

Either positive or negative terminal may be grounded. Total noise and hum is reported as less than 0.005 volts for any condition of variation. The unit also provides 6.3 volts a.c. center-tapped for filament heating. Unit weighs 18 lb.

•

Tester Facilitates Selection Of Insulating Enamels

A NEW core-plate enamel tester designed for measuring the insulating value of enamel coating on sheet steel or steel punchings has been announced by the General Electric Co., Schenectady, N. Y. It consists of a test



head, a hydraulic press and a control unit. The new instrument is useful for testing rotor cores as it simulates the conditions of heating and pressure which may exist in a core.

The core-plate enamel test head has 10 insulated brass contact buttons backed by spiral springs which give independent pressures of from 500 to 750 lb. psi. These are mounted beneath a steel base upon which two ½-in. twist drills are located. The test head itself is mounted on the upper plate of a "C"-shaped hydraulic press, and a heater is mounted on the lower plate of the press. The control unit is the source of power, and contains the indicator for the enamel resistance measurement. The jack has a capacity of 20,000 lb. and the heater has a maximum temperature rating of 300 deg. C.

•

Selenium Rectifier Withstands 26 Volts per Plate

NEW selenium rectifier series has a double stud, center contact construction and is designed to withstand a reverse voltage of 26 rms. volts per plate according to Federal Telephone & Radio Corp., Newark, N. J. It is designed for use where power requirements are heavy such as in arc welding, cathodic protection, electroplating, anodizing equipment and in large battery chargers.

The stack is designed for use either in horizontal or vertical position with plates in parallel, series or series-parallel connections depending upon load demands.

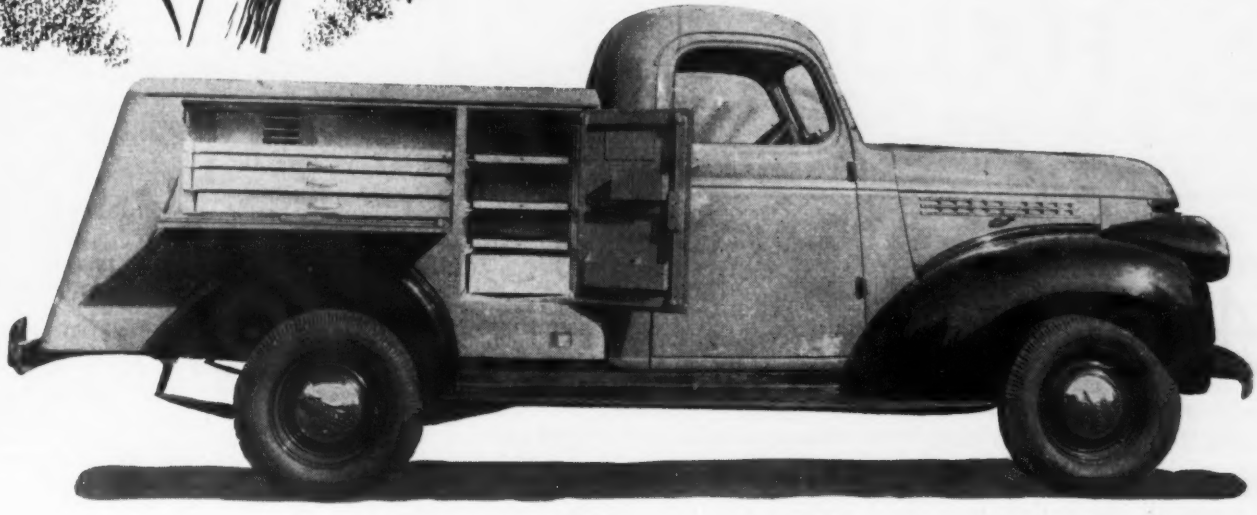
2050 Is a Good Number!

YORK-HOOVER

Light Service Body

MODEL 2050

SAVES TIME, MONEY and INCREASES EFFICIENCY



Three Reasons Why

DESIGN . . . compact and convenient with specific compartments for correct tools, parts, and materials for efficient service work.

ADAPTABILITY . . . bodies can be serviced and remounted from one conventional ½ ton chassis to another.

CONSTRUCTION . . . all-metal construction with reduced body weight provides "take it" ability that assures constant trouble-free operation.

Be "Body-Wise" . . . Consult US.

ARMY E NAVY

YORK-HOOVER CORPORATION

BODY DIVISION

YORK, PENNSYLVANIA

40 Years' experience plus modern design is built into every R&S product.

R&S reflector contours are scientifically designed with high reflection factor providing a maximum of safe controlled light at minimum cost.

Thorough inspection and rigid factory controls insure longer life and low maintenance.

R&S explosion-proof lighting fixtures are supplied with a standardized base common to all sizes. Reflector globe assemblies of various capacities are interchangeable to suit conditions. No need to disturb mounting or electrical connections. Modern design simplifies mounting and affords a variety of conduit arrangements in one standard base. Installation costs are lower, parts fewer and ordering easier.

In hazardous areas, you can't afford to experiment. R&S explosion-proof and vaportight lighting fixtures are precision built and pass the rigid tests of Underwriters' Laboratories.

Specify R&S and be sure. Write for our 300-page catalog. You will find it valuable in planning new work and bettering existing installations to meet tomorrow's standards.

Since 1902

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RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES AND EQUIPMENT. AUTOMATIC LOCKING "EVER-LOK" CONNECTORS

125 BARCLAY STREET · NEW YORK 7, N. Y.

TECHNICAL LITERATURE

Welding—Standard Code for Arc and Gas Welding in Building Construction, 1946 edition, has been completed and replaces the 1941 edition. The new edition embodies revisions based on experience in recent applications of welding to structural fabrication and on further research investigation. Copies may be obtained from the American Welding Society, 33 West 39th St., New York 18, N. Y., at 50 cents per copy.

Mica Standards—"Standards for Manufactured Electrical Mica," publication No. 46–117, contains information concerning the manufacture, test, performance and nomenclature of manufactured mica sheets used in the manufacture of electrical apparatus and supplies. It supersedes publication No. 39–55. Copies may be secured from National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y.

Alloys—A 184-page publication entitled "Standards on Electrical-Heating and Resistance Alloys" comprises 30 important tests and specifications. These include four tests for electrical resistance alloys, two proposed specifications and one proposed method of testing electric furnace alloys, one specification and twelve tests for tube and lamp materials, three tests for heat-resisting alloys, and two tests for thermostat metals. Also included is a paper, "Calculation of Electrical Contacts Under Ideal Conditions," by E. I. Shobert II, Stackpole Carbon Co. Copies are available from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $2.00 per copy.

ASA Miscellaneous Conifers—Properties, dimensions suitability for treatment and use as poles, regional prevalence, etc., of the fourteen timbers approved as an ASA War Standard. 27 pages, maps. Obtainable from J. P. Wentling, Wood Technologist, Consolidated Treating Co., Minneapolis, Minn.

Deaerators — Technical description and discussion of Atomizing Deaerators is given in Publication No. 4160 which is obtainable from Cochrane Corp., Philadelphia 32, Pa.

Servomechanisms—Outline of the three basic units of electronic servos, basic functions which they will perform, and their operating features is available from G. C. Wilson Co., Chatham, N. J.

Lighting—"Your Place in the Sun" is a 23-page booklet showing how 120 light bulbs can contribute in making an average house into a charming home. It contains practical ideas of obtaining modern lighting in each room. Copies are available from the lamp department, General Electric Co., Nela Park 12, Ohio, for 10 cents each.

Conductor Vibration—A comprehensive bibliography on vibration in electrical conductors (including galloping and glaze troubles and also wind force information) has been prepared by A. E. Davison of the Hydro-Electric Power Commission (Toronto) in conjunction with the Transmission and Distribution Committee of the A.I.E.E. Copies may be obtained, while they last, from either source.

Alloys—Standards for Electrical-Heating and Resistance Alloys, with related information, are now available in bulletin form from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. The booklet covers the structural and electrical-resistor materials for furnaces, materials for lamps and radio tubes, contact and thermostat materials, as well as heating and resistance materials.

(ADVERTISEMENT)

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Corrosion-Resistant Alloys Increase Efficiency, Cut Maintenance Costs

Although the principal use for tubing in power plants for land stations and ships is in surface condensers there are, of course, many other applications, such as oil coolers, hydrogen coolers, boiler feedwater heaters, jet condensers and other vital equipment, where corrosion-resistant tube alloys are required. Unsatisfactory performance of such tubing can seriously affect operation of the entire plant by interrupting the smooth flow of service and increasing maintenance and replacement costs.

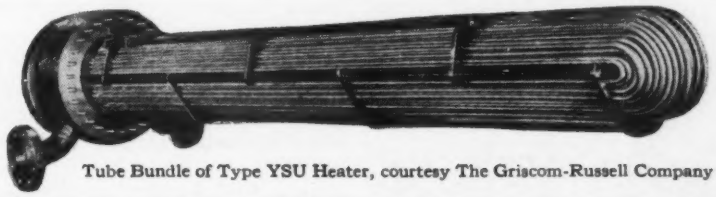
Importance of Alloy Selection

Every power plant engineer realizes the necessity for keeping expenses down, particularly in view of the fact that manpower and materials cost so much more these days. They realize the necessity for greater efficiency to help offset higher costs, and recognize the importance of modern tube alloys, developed in recent years to withstand more severe operating conditions. Although in some cases the first cost may be higher, the added service life and lower maintenance make such tubing more economical in the long run. It will, therefore pay power plant engineers to give the most careful consideration to metal specifications involving engineering requirements. Since water and operating conditions are subject to change with the passage of time, experience has shown that the use of the same tube alloy, which may have been satisfactory before does not always work out. By doing a little spade work in the form of installing several test lots of tubing made from different alloys it is possible to determine more accurately which alloy will best serve existing conditions.

Listed herewith are a number of applications for copper-base alloy tubing in power plants, with the alloys most generally used. Operating conditions, equipment design, nature of the gas or liquid handled and other factors must be taken into consideration.

Applications For Copper-Base Alloy Tubing in Power Plants

- Air Cooled Heat Exchangers (Copper Fins on Admiralty or Copper)
- Auxiliary Steam Evaporators (Admiralty)
- Boiler Blowdown Heat Exchangers (Admiralty, Muntz Metal or Cupro Nickel)
- Boiler Feed Make-Up Water Evaporators (Admiralty or Cupro Nickel)
- Compressed Air Coolers (Admiralty, Copper or Red Brass)
- Compressed Air Lines (Copper)
- Condensate Coolers (Admiralty, Muntz Metal or Copper)
- Diesel Lubricating Oil Coolers (Admiralty, Muntz Metal or Copper)
- Diesel Jacket Water Coolers (Admiralty, Muntz Metal or Copper)
- Economizers (Admiralty)
- Evaporators (Admiralty, Copper, Muntz Metal or Red Brass)
- Evaporator Condensers (Admiralty, Aluminum Brass, Duronze IV or 70/30 Cupro Nickel)
- Exhaust Gas Water Heaters (Admiralty or Aluminum Brass)
- Feed Water Heaters (Admiralty, Copper or Muntz Metal)
- Fuel Oil Heaters (Copper or Admiralty)
- Fuel Oil Lines (Copper, Admiralty or Red Brass)
- Generator Air Coolers (Admiralty or 70/30 Cupro Nickel)
- Gland Steam Condensers (Admiralty, Muntz Metal or Copper)
- Hydraulic Pressure Lines (Copper or Duronze V)
- Hydrogen Coolers (Admiralty or 70/30 Cupro Nickel)
- Instrument Tubing (Copper or Duronze V)
- Intercoolers and Aftercoolers (Admiralty)
- Lubricating Oil Coolers (Admiralty, Muntz Metal, Red Brass or Copper)
- Refrigeration or Cooling Equipment (Admiralty, Copper or Duplex Tubes) made up of a copper-base alloy and steel.
- Steam Condensers (Main or Auxiliary) (Admiralty, Aluminum Brass, Muntz Metal, Duronze IV, Copper or 70/30 Cupro Nickel)
- Tank Suction Oil Heaters (Copper, Admiralty or Muntz Metal)
- Turbine Oil Coolers (Admiralty, Muntz Metal, Aluminum Brass, Duronze IV or 70/30 Cupro Nickel)
- Unit Heaters and Coolers (Copper or Admiralty)
- Vent Condensers (Admiralty, Red Brass or Muntz Metal)
- Water Heaters (Copper, Admiralty or Red Brass)
- Waste Water Heat Exchangers (Copper, Admiralty, Muntz Metal or Red Brass)
- Water Lines (Copper, Red Brass or Muntz Metal)



Tube Bundle of Type YSU Heater, courtesy The Griscom-Russell Company

Wide Range of Alloys Available

Each year Bridgeport supplies to customers many millions of pounds of corrosion-resistant tubing which is subjected to a wide range of operating conditions. For clean fresh water Arsenical Muntz Metal, Red Brass and Arsenical Copper are giving fine service. For good general corrosion resistance to low velocity sea water, Arsenical Admiralty is frequently recommended. Where sea water has particularly high velocity (over 7 ft. per second) which causes ordinary alloys to fail from impingement corrosion Aluminum Brass is giving very satisfactory service. 70/30 Cupro Nickel is recommended for rapidly flowing sea water, and has the ability to function satisfactorily at higher operating temperatures. The U. S. Navy specifies 70/30 Cupro Nickel for war ships and other vessels.

Bridgeport's Duronze IV (arsenical aluminum bronze) is one of the finest tubing alloys made. It has stood up well under such difficult conditions as harbor water polluted by sewage and factory wastes and in tidal estuaries where salt water is mixed with polluted fresh water. Duronze IV also has fine resistance to impingement corrosion.

Bridgeport's Duplex Tubing

Where corrosion is too severe for a single metal or alloy—simultaneous attack on the inside and outside by different corrosive elements—engineers should consider Bridgeport's Duplex Tubing. It is available in combinations such as copper-base alloys with low carbon steel, stainless, monel, aluminum or nickel. Bridgeport's Duplex Tubing is solving many severe double corrosion problems. For example, it is being used successfully in ammonia refrigeration equipment with steel to the ammonia side and a copper-base alloy to the water.

Technical Service Department

To determine the condition and life expectancy of your condenser and heat exchanger tubes our laboratory will gladly work with you. Care in sampling, however, is important and this matter should be taken up with us before sample tubes are removed. To help in the selection of the most suitable tube alloy we also offer the services of our Technical Service Department, composed of laboratory-trained men. In the meantime write for Bridgeport's 112-page Condenser Tube Manual.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

NEWS ABOUT PEOPLE

Georgia Power Makes Roberts Vice-President

Charles Wert Roberts, former Macon division superintendent, has been named to succeed the late B. R. Chestney as vice-president and Macon division manager of Georgia Power Co.

W. E. Hollingsworth, assistant division superintendent, has been appointed di-

C. W. Roberts

vision superintendent, succeeding Mr. Roberts.

A native of Wadley, Ala., Mr. Roberts was graduated from the Alabama Polytechnic Institute at Auburn with a degree in electrical engineering in 1927. After two years with the General Electric Co. in Schenectady, he joined the operating department of Georgia Power in Atlanta in January, 1929.

Mr. Roberts was transferred to Augusta in March, 1930, where he served as assistant division superintendent until December, 1936, when he was made division superintendent. In October, 1938, Mr. Roberts was transferred to Macon as division superintendent.

Mr. Hollingsworth has been assistant Macon division superintendent for the past eight years. Before going to Macon, he was assistant superintendent of the Columbus division.

A native of Fairburn, Ga., Mr. Hollingsworth attended the Ocilla schools and the Marion Institute at Marion, Ala., before being appointed to the United States Naval Academy. In 1924 he was appointed superintendent of the Ocilla Water and Light Department, and in 1926 he became local manager at Ocilla for a predecessor company. He was promoted to district manager in 1935 and in the next year was made assistant superintendent of the Columbus division.

•

Aluminum Co. Names Bohn Chief Electrical Engineer

Donald I. Bohn has been appointed chief electrical engineer of the Aluminum Co. of America to succeed Thomas J. Bostwick, who has retired after occupying that position for the past 22 years. Mr. Bostwick will continue to be available to the company and its subsidiaries as consulting electrical engineer. Succeeding Mr. Bostwick as assistant chief electrical engineer is Louis N. Grier.

Mr. Bohn has been identified with the company since 1923. He was made as-

D. I. Bohn

sistant electrical engineer in 1928, and has been responsible for numerous inventions in the electrical engineering field.

Mr. Grier joined the company in 1919. He has been actively involved in the planning for practically all of Alcoa's major building operations since 1925.

•

▶ R. J. Beaumont, vice-president of the Shawinigan Water & Power Co. in charge of distribution, has been made a vice-president of the Quebec Power Co., a subsidiary of Shawinigan. Mr. Beaumont has been a director of Quebec Power since 1940.

Darland Assigned New Duties on Columbia Basin Project

Alvin F. Darland, formerly superintendent of Tacoma City Light, has returned to the Bureau of Reclamation's Columbia Basin Project headquarters at

A. F. Darland

Coulee Dam in an administrative position under Supervising Engineer Frank A. Banks.

In his new assignment, Mr. Darland will direct all construction, operation, and maintenance activities for the Coulee Dam area and for the equalizing reservoir in the Grand Coulee, and the South Dam, near Coulee City.

When Mr. Darland left government service at Coulee Dam in 1945, to become superintendent of Tacoma City Light, he completed an eleven-year association with the Columbia Basin Project. Following graduation from the University of Washington in 1914 he joined Tacoma City Light, but left a year later to go with the General Electric Co. Returning to Tacoma in 1916, he engaged in general engineering work, planning of plant extensions and investigations of rate structures. From 1918 to 1922 he served as electrical superintendent for the Todd Dry Dock & Construction Corp. in Tacoma. In 1923 Mr. Darland became superintendent of electrical design and construction with the Department of Public Utilities for the City of Tacoma.

•

▶ Ben Templeton has resumed the duties of manager of the McCulloch County

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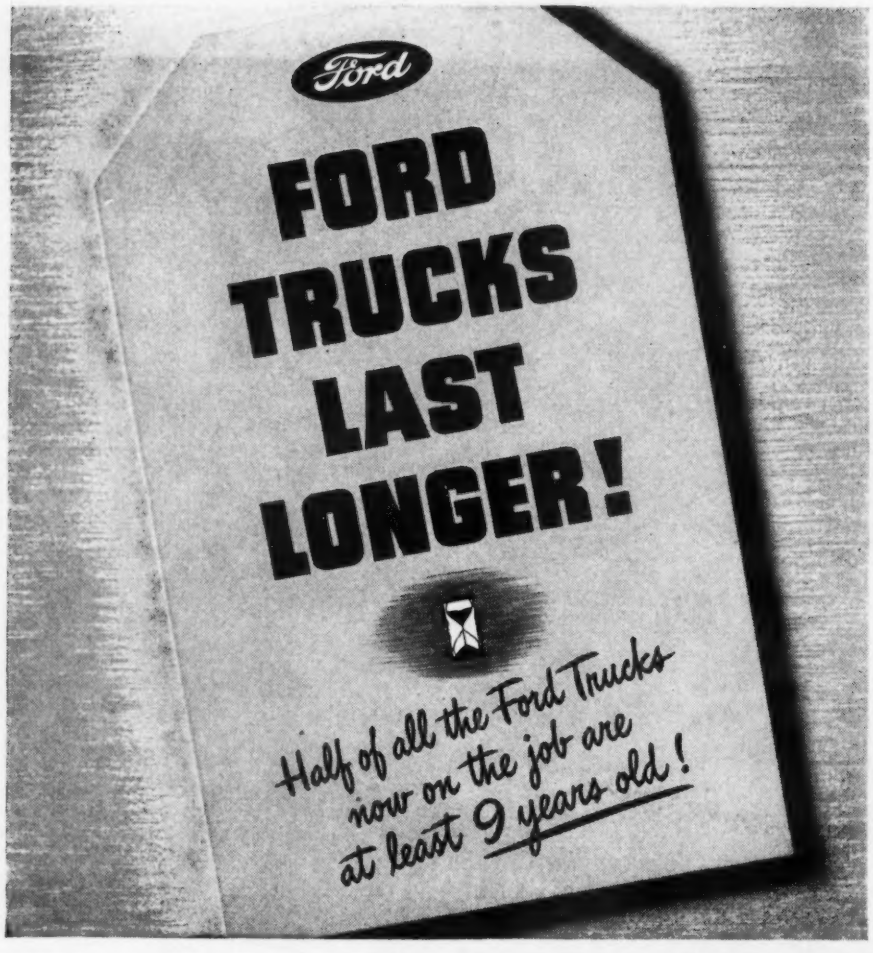

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Engineering Service Representatives in all principal cities.

Electric Cooperative, Brady, Tex. He formerly served for more than four years as manager of the Navarro County Electric Cooperative at Corsicana, Tex.

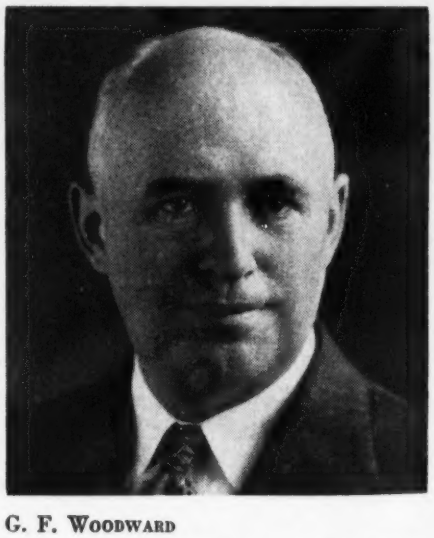
•

New England Engineers Take Over New Responsibilities

Kenneth W. Proctor, recently appointed district superintendent of distribution for the New England Power

K. W. Proctor

System companies in the central district, with headquarters at Worcester, Mass., as noted in Electrical World, July 13, was graduated from the Massachusetts Institute of Technology in 1925. He



G. F. Woodward

joined the Malden (Mass.) Electric Co. as a student engineer, becoming assistant electrical engineer in 1927, assistant superintendent in 1934 and superintendent in 1937. In 1939 he was made general superintendent, and since 1943 has been assistant to the manager. He is a former chairman of the Electric Lines Club of New England and has been a member of the New England Power System standards committee.

Guy F. Woodward, whose appointment

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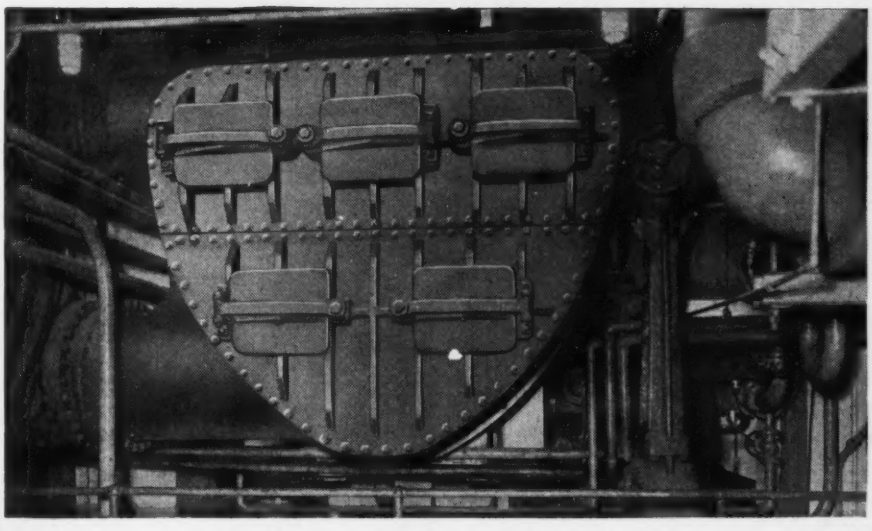
ATLANTIC CITY UTILITY Completely Modernizes Plant

Second Hydrogen-Cooled Generator Unit Being Installed



Surface-type steam condenser at Atlantic City Electric Co. With a total of 17,000 sq ft of tube surface, this unit condenses more than 200,000 lbs of steam per hr.

Ingersoll-Rand Condensing Plants Serve New High-Pressure Turbines

ATLANTIC CITY ELECTRIC COMPANY, an American Gas and Electric Company subsidiary, serves not only New Jersey's amusement and resort center but one of the fastest-growing industrial centers in south Jersey. The growth of this load, as well as that of Atlantic City proper, has called for two expansions of Atlantic City's generating facilities within the last few years.

Two complete generating units, each of nominal 25,000 kw rating, complete the present modernization program. These units are known as Generators No. 6 and No. 7, respectively. No. 6 is now on the line, and No. 7 will go into service next year.

Each installation is a separate and independent unit, and has its own boiler plant, condenser equipment, and pumping facilities. Each unit has an extraction-type turbine, a hydrogen-cooled generator, and a new water-tube and water-wall boiler. Steam for the second unit will be supplied at 1000°F and 1400-psi. Ingersoll-Rand high-efficiency surface-type steam condensers and air-removal equipment were ordered for both turbines.

Ingersoll-Rand Company has been manufacturing steam condensing apparatus and related equipment for many years. The most careful attention has been consistently devoted to the needs of utility stations, marine power plants, and process industries.

Surface condensers have been built in sizes ranging from 200 to 160,000 KW in capacity and operate successfully under a wide variety of conditions in both domestic and foreign land and marine power plants. The equivalent prime-mover capacity for which Ingersoll-Rand condensers have been provided, is over four-million kilowatts.

Ingersoll-Rand pioneered the high efficiency condenser over twenty years ago, and since that time has maintained leadership by following a continuous program of development which is aided by exceptional facilities for accurate testing and full scale experimental work.

There is an Ingersoll-Rand condenser for every size and type of turbine. Many recent orders have been for the complete condensing plant, including the condenser, air removal equipment, circulating water pumps, condensate pumps, and auxiliary pumps. Ingersoll-Rand condenser specialists are ready to help with your problems.

Two Ingersoll-Rand Motorpumps handle condensate from the primary hotwell below the steam condenser. Each pump can handle 500 gpm against a head of 110 ft.

Vertical propeller-type pumps deliver up to 16,000 gpm cooling water to the surface condenser. These are 100-hp units.

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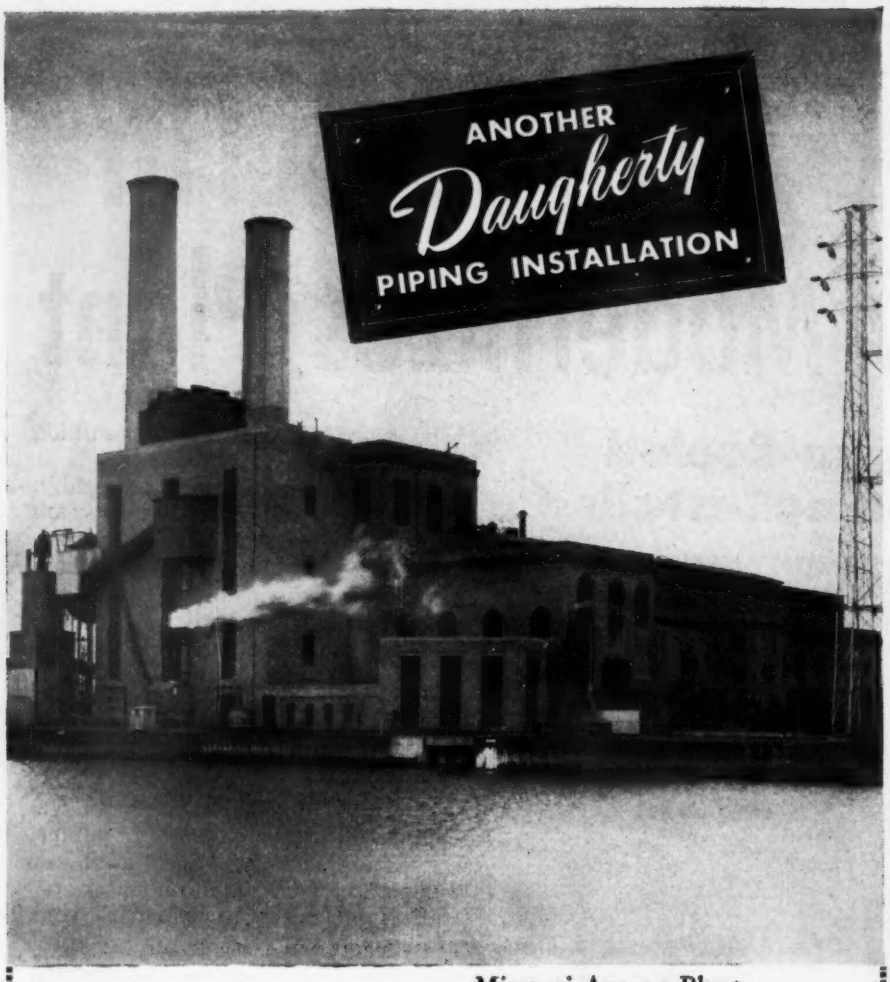
Ingersoll-Rand, 11 Broadway, New York 4, N.Y.



Missouri Avenue Plant
Atlantic City Electric Co.
Photo taken prior to major addition now under construction.

The choice of Daugherty Company to handle the erection of piping for the *1000 degree steam installation* now being added to this well known station is further testimony to the successful experience of Daugherty Company in handling complex power and process piping.

Daugherty Company offers these facilities for power and process piping work: FABRICATION of high pressure, high temperature piping including alloy tubing. EQUIPMENT for field stress-relieving and radiographic inspection. WELDERS qualified for all classes of work. SUPERVISION by an unexcelled metallurgical, engineering and construction staff.

Daugherty Company, Inc.

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PIPING CONTRACTORS for the POWER and PROCESS INDUSTRIES

as superintendent of distribution of the Worcester County Electric Co., Worcester division, following the retirement of George M. Hardy, has been briefly recorded by ELECTRICAL WORLD, July 13, is a native of Clinton, Mass. He was educated at Worcester Polytechnic Institute and entered the Worcester company's service in the meter department in 1920. Through the 25 years following he has been promoted through various positions until he attained that of assistant superintendent of distribution, which he held until his latest advancement. Mr. Woodward's technical and administrative capacities have played an important part in departmental development and methods organization in the Worcester company's progress in close association with his former superior.

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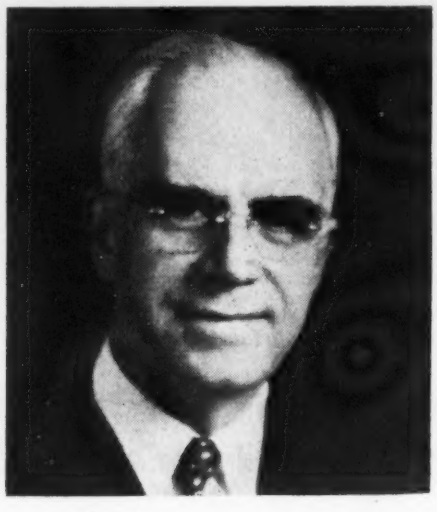
Wagner Electric Makes 3 Executive Appointments

Three executive appointments have been announced by the Wagner Electric Corp., St. Louis. G. A. Waters, chief engineer, has been named vice-president in charge of manufacturing; F. F. Simon, controller, is now vice-president and controller; and K. M. Coggeshall, production manager, has been made assistant vice-president in charge of production and purchasing.

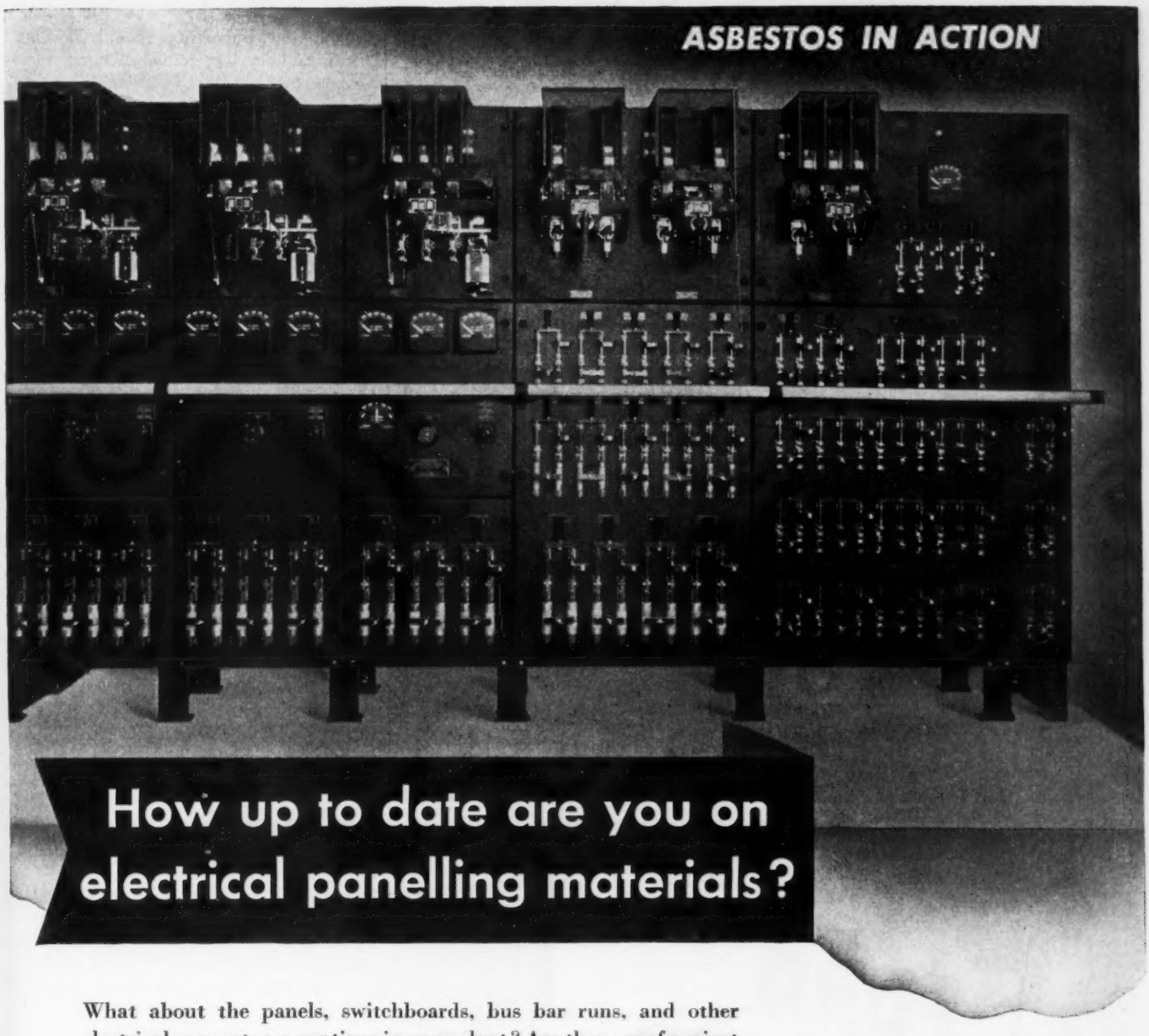


G. A. WATERS

Mr. Waters, who received his electrical engineering degree from Syracuse University in 1907, joined the company in 1909 as a student engineer. He has been active in the American Institute of Electrical Engineers, the Society of Automotive Engineers, and the National Electrical Manufacturers Association.

Mr. Simon, who received the degree of mechanical engineer from Penn State University in 1909, has been with the company since 1917. He became controller in 1934 and in January became a director of the company.

Mr. Coggeshall, a graduate of the



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What about the panels, switchboards, bus bar runs, and other electrical apparatus mountings in your plant? Are they proof against absorption of moisture and oil? Do they stand up under high voltage surges, vibrations, and temperature changes, retain a business-like appearance without costly maintenance?

You can answer "yes" to all those questions if your electrical apparatus is mounted on K&M Ebonized Asbestos, the *modern* panelling material. Fabricators who work it and plants that use it say Ebonized Asbestos is ideal for the purpose.

Made of tough asbestos fibres, cement and an insulating compound, K&M Ebonized is moulded into strong monolithic sheets with exceptionally high dielectric strength. It gives extra-long service, in fact it grows tougher with age. Meets the requirements of Underwriters' Laboratories, Inc., when built into an assembled unit. Write us for full technical data on this superior mounting material.

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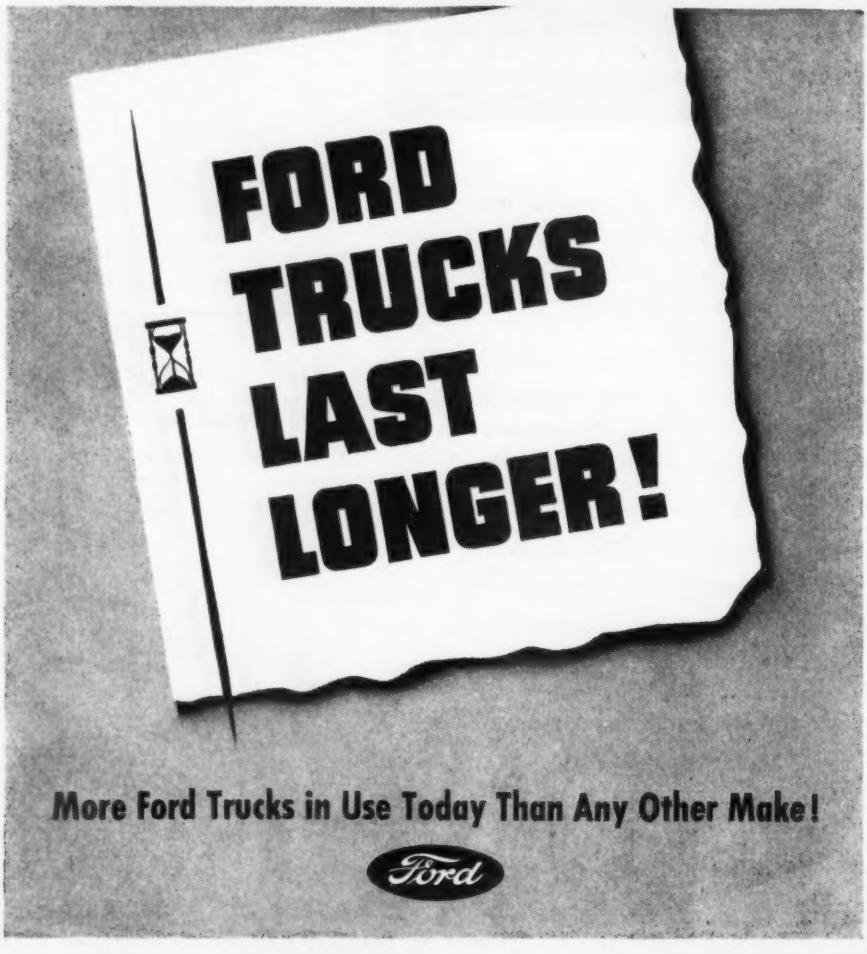

Washington University School of Electrical Engineering, joined Wagner Electric in 1915 as a student engineer. In 1926, he became production manager.

•

▶ ELMER C. NEUSSE has been appointed chief engineer of the Connecticut Public Utilities Commission, Hartford, following two years' service as associate utility engineer with that board. He was graduated in electrical engineering from the University of Wisconsin in 1926; was structural engineer for four years with the Chicago elevated lines; spent four years with the consulting engineering firm of Spooner & Merrill, Inc., Chicago, largely on valuation work; and then served four years as electrical engineer for the Wisconsin commission. Mr. Neusse was then employed for six years by the Rochester (N. Y.) Gas & Electric Corp., in inventory work, going to Connecticut in 1944.

▶ A. E. PITTS has taken over the duties of city utilities manager at Bandon, Ore. Mr. Pitts is an electrical engineer and recently was identified on a government power project in Richland, Wash., in the capacity of field engineer. Mr. Pitts had 14 years' experience in the public utility field in Oklahoma previous to that time.

▶ PROF. H. JERMAIN CREIGHTON, head of the chemistry department of Swarthmore College since 1928, has been awarded the Edward Goodrich Acheson gold medal and thousand dollar prize for his outstanding accomplishments in electrochemistry. Dr. Creighton served as president of the Electrochemical Society 1939-1940. The Franklin Institute awarded him the Longstreth Medal in 1918 and the Howard N. Potts gold medal in 1939 in consideration of his distinguished work in developing a process for the electrolytic reduction of simple sugars on a commercial scale. In 1940 the National Association of Manufacturers presented the "Pioneer Award" to him on account of his work on sugars. The presentation of the Acheson award is scheduled for October 17 at Toronto, Ont., in conjunction with the congress of the Electrochemical Society.

▶ THURMAN OAKLEY, formerly superintendent of the meter department of the Illinois Power Co., Decatur, Ill., has been appointed superintendent of the Madisonville, Ky., light and water plant. He succeeds L. B. HERRINGTON, resigned.

▶ C. B. HARLOW has retired as vice-president and central division sales manager of the Benjamin Electric Manufacturing Co., Des Plaines, Ill. His long association with Benjamin started in 1914 and he has been a vice-president since 1936. The

DISSOLVED OR ENTRAINED AIR

in circulating water—one of many factors governing condenser tube and heat exchanger tube performance—is presented in this discussion by Scovill engineers on selection of the proper tube alloy.

Fast-flowing rivers, rapidly changing tides, spray ponds and moving ships all create a condition causing entrainment of air. Furthermore, all raw water is saturated with dissolved air. Approximately 2.7 cu. ft. of air will dissolve in 1000 gal. of water — the quantity of air to saturate being dependent on the water pressure, composition and temperature. Any low-pressure areas in the circulating system permit the liberation of part of this dissolved air to ally itself with any free air in its erosive-corrosive attack on the tubes.

In actual operating conditions, where dissolved or entrained air in the circulating water is only one of the variables, tube life depends on the nature and/or extent of such other factors as: Velocity and turbulence of coolant . . . Chemical composition of circulating water . . . Temperatures inside and outside of tubes . . . Chemical or electro-chemical actions . . . Marine growths or other deposits . . . Sewage and wastes present . . . Development of protective film . . . Media surrounding tubes.

One of the principal objects of Condenser Tube Technical Research has been the development of alloys designed to give the user longest tube life and most trouble-free service. Where the major factor affecting tube life is the presence of dissolved or entrained air, satisfactory alloys include Cupro-Nickel, Aluminum Brass and Phosphorized Admiralty, each within its temperature limitations.

So many variables surround any condenser or heat exchanger tube application that each case must be treated as an individual problem.

Data accumulated during Scovill's continuous study of condenser and heat exchanger tube service conditions for every known application equip its Technical Service Department to offer sound guidance in tube alloy selection for existing or proposed installations.

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Scovill's *Service in Men* offers experienced engineering to help solve your tube selection and installation problems. *Service in Metals* develops and produces Scovill tube alloys that conform to your requirements. *Service in Manuals* consists of literature which gives you latest, authentic information on condenser and heat exchanger tubes. For a free copy of Condenser Tube Booklet, address Scovill Manufacturing Co., 24 Mill St., Waterbury 91, Conn. *Export Dept.* 405 Lexington Ave., New York 17, N. Y.

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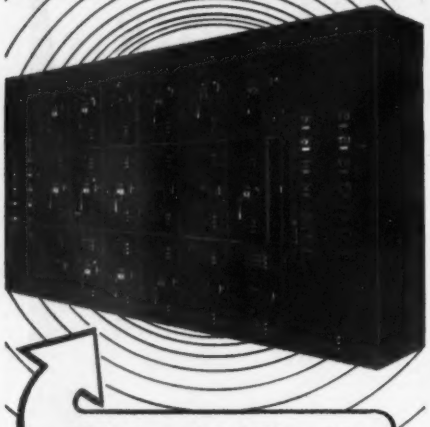
Pelham

for your next Switchboard



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2. Highest Standards. The wide preference for Pelham Switchboards is largely due to the knowledge of electrical engineers that "Pelham" on a board definitely guarantees the best of materials and workmanship.

3. Unusual Cooperation. We take full responsibility for meeting all specifications of architects and engineers, as well as municipal, state, or federal requirements. Our deliveries are made when promised.

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Erie, Pa.

SPECIALIZED DESIGN
Pelham
UNEXCELLED QUALITY
SWITCHBOARDS · PANEL BOARDS
SWITCH GEAR AND ACCESSORIES

new central division sales manager is A. E. SWEDENBORG, who has been with Benjamin since 1922 and for many years worked as a field engineer in Michigan.

▶ EDWARD N. WENDELL, who has been associated with the International Telephone & Telegraph Corp. system since 1925, has been appointed vice-president in charge of the Federal Telephone & Radio Corp., domestic manufacturing affiliate of I. T. & T. Mr. Wendell has been with FTR since its formation in 1942 from predecessor companies.

▶ DR. WILLARD H. DOW has been awarded the Chemical Industry Medal for 1946, the Society of Chemical Industry has announced. President and chairman of the Dow Chemical Co., Midland, Mich., a wartime leader in the production of synthetic rubber, and pioneer in sea-water chemistry, Dr. Dow was cited for his "conspicuous service to applied chemistry." Under Dr. Dow's direction, the Dow Chemical Co. carried out for the government and armed forces more than 50 major war-time projects. Besides supervising the extensive war work of the company, Dr. Dow served on the Chemical Advisory Committee of the Army and Navy Munitions Board, and on the Chemical Warfare Service Advisory Board. The Chemical Industry Medal, which will be presented at a dinner at the Hotel Commodore, New York, on November 8, is the third high scientific award won in recent years by Dr. Dow, who is a director of the American Chemical Society.

▶ CALVIN R. MACBRIDE has been appointed assistant manager of the products division of Du Pont's plastics department. Mr. MacBride, who has been assistant manager of the industrial division since 1929, will transfer his headquarters from the plant at Arlington, N. J., to the product division's offices in the Empire State Building, New York. DR. ROBERT M. EVANS, who has been manager of the division handling the company's part in the atomic energy project, has been made assistant manager of the industrial division of the plastics department. Dr. Evans started with Du Pont in 1925 and for 18 years was connected with Du Pont's development of pioneer processes for the high-pressure synthesis of ammonia and other chemicals.

OBITUARY

▶ EDWIN N. HAZLETT, railway and utilities sales engineer in the Cleveland office, Phelps Dodge Copper Products Corp., died at St. Petersburg, Fla., July 10, at the age of 41 years. He was connected with the Duquesne Light Co. and with the Copperweld Steel Co. as district representative in Cleveland before joining Phelps Dodge.

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No. 324 Simplex Wire Tensioning Jack: 2-tons capacity, 20¼" take-up with every grip. Weighs only 13 lbs.

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MANUFACTURERS & MARKETS

Farm Market for Equipment and Appliances Good

Farm Equipment To Be Purchased

Equipment	Iowa	Wis.	Neb.	The Dakotas	Ind. Ill.	Minn.
Pressure Water Systems	20.1	21.1	18.7	21.7	17.0	21.9
Hay Curing Equipment	2.6	3.3	2.9	3.4	2.0	3.9
Grain Elevating Equipment	13.4	14.6	16.9	22.8	10.0	13.8
Feed Grinders	8.8	0.5	12.6	12.7	11.0	6.6
Welders	6.2	10.8	10.8	16.1	8.0	11.4
Milk Coolers	4.1	18.3	2.2	7.9	5.0	12.0
Milking Machines	12.4	12.7	6.8	10.5	9.0	11.7
Poultry Brooders	4.6	9.9	7.9	9.7	7.0	4.8
Home Freezers	31.4	31.9	24.8	29.2	33.0	36.6
Refrigerators	28.9	34.7	44.6	48.3	30.0	36.6
Ranges	14.9	16.0	18.0	20.6	11.0	15.6
Water Heaters—home	21.1	30.5	20.5	27.7	22.0	24.9
Water Heaters—milk house	4.1	15.5	1.8	6.4	6.0	9.3
Automatic Clothes Dryers	3.6	3.3	3.2	5.2	3.0	4.8
Ironers	8.2	7.5	8.3	10.9	5.0	9.0
Radios	23.2	21.6	23.4	30.7	24.0	20.7
Vacuum Cleaners	20.6	15.5	16.6	20.2	19.0	18.9

The market for farmstead electrical equipment to raise the output per man hour and to ease the manual labor burden, and the market for domestic appliances to raise the rural standard of living is ever on the increase as rural lines are extended and farm income increases, Russell J. Gingles, manager of farm electrification bureau, National Electrical Manufacturers Association stated this week.

An indication of the electrical equipment which farmers expect to purchase as soon as available is given in the accompanying table. Over 1,500 farm families were interviewed in each state by an independent agency and the results tabulated in percentages.

Gingles, when interviewed by a representative of ELECTRICAL WORLD, stated "that approximately $1,000,000,000 is now being spent or has already been allocated for line construction or for service improvement, that the outlay for wiring should approximate $500,000,000 and that $2,500,000,000 will be spent for farmstead electrical equipment and home appliances." He stated that this market for electrical goods is particularly good now since farm income and savings have been abnormally high. Savings in 1945 were 2½ times the 1935-1939 average, he added.

To bring about the most efficient use of this equipment, Mr. Gingles stated that representatives from the power suppliers and the manufacturing fields will meet with agricultural engineers and educators in Chicago on November 7, at the National Farm Electrification Conference to discuss the adaptation of this equipment to the broadening rural market.

Open Texas Technical Unit

International Nickel Co., Inc., has announced the opening of the Texas technical section of its development and research division, which is located in the Bankers Mortgage Building, Houston. It will furnish to industry technical information and assistance relating to alloys containing nickel. The section's activities will cover the states of Texas, Oklahoma, Louisiana, Mississippi and the southern half of Arkansas. R. J. Rice, metallurgical and chemical engineer, will be in charge.

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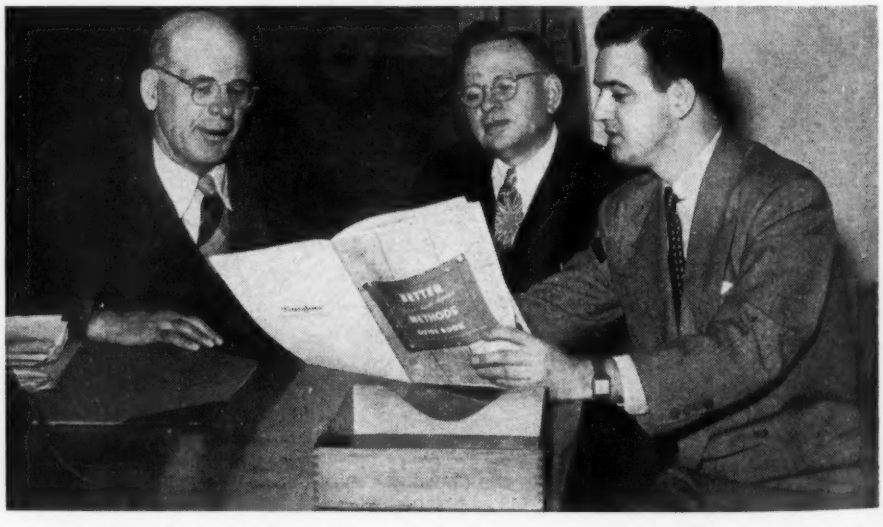
Lighting Fixture Prices Boosted 10% by OPA

Manufacturers of lighting fixtures and component parts have been given a 10 percent interim increase over base ceiling prices, the Office of Price Administration announced this week. The rise covers all types of incandescent and fluorescent non-portable fixtures for industrial, commercial and residential use.

At the same time, resellers were permitted to raise their maximum prices by the same percentage. OPA explained that the increase was granted as a result of a preliminary check made by the agency after the Lighting Fixtures Advisory Committee advised that rising costs made the former ceiling prices too low.

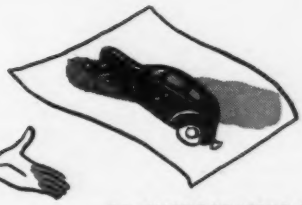
The interim increase was granted on the basis of data submitted by nine producers in individual adjustment applications. These applications were processed on varying bases and the increase factor



HEAD, HEART, HEALTH, HAND—Cooperation of educators, power company officials and manufacturers is bringing about bigger and better 4-H clubs whose interest lies in the utilization of electric power on the farm. At the University of Minnesota, A. J. Kittleson, Minnesota state club leader, and C. P. Wagner, manager of Northern States Power Co.'s farm service department, are shown going over the "Better Methods Guide Book" with A. D. Palmer, manager, Westinghouse Electric Corp. public relations promotion department. In the 1946 4-H Westinghouse contest more than 60 power companies are cooperating with clubs by stimulating interest in the six college scholarships and the 48 free trips to Chicago available to the winners

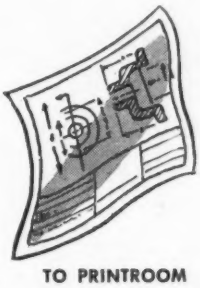
TO TYPISTS

Individually typed form letters are required.



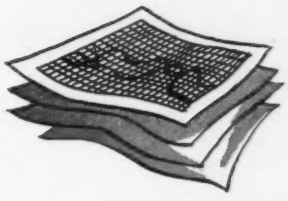
TO PHOTOGRAPHIC DEPARTMENT

Copies of this continuous-tone picture are needed.



TO PRINTROOM

Prints of this draftsman's drawing must be made.



TO ART DEPARTMENT

These statistics must be reproduced in different colors, in transparent overlay form.

"DON'T SCATTER THESE JOBS!"

IT'S not necessary to scatter jobs like these to the four winds!

Every one of them (and hundreds of others, besides) can be completed in a compact Ozalid machine, installed anywhere in your plant, and operated by anyone.

You'll find that Ozalid is the fastest, the most efficient, the *only* way to eliminate waste of time, labor, and materials in these everyday operations:

SAVE IN THE PRINTROOM! Your draftsmen's tracings (or any other translucent originals) are reproduced in seconds as positive (not negative) easier-to-read prints. And *add* this versatility: You get reproductions in the color you prefer—black, blue, red, or sepia . . . and on the material you prefer—paper, cloth, foil, film, or plastic.

Thus, you match the print to the job. For example, make prints that are waterproof, oilproof . . . or are "color-coded" to identify the work of different departments or operations.

SAVE TYPING! Instead of typing thousands of form letters to sales prospects, etc., simply: (1) Type your message *only once* on a translucent letterhead. (2) Make the desired number of Ozalid black-line prints. (3) Fill in headings, personal references, etc., with the same make of typewriter used originally.

Your letters will have the dignity of original typing . . . and will cost only about a cent each. You'll use the same system to duplicate reports, minutes of meetings, etc.

SAVE ART! Here's how quickly you can make 5 color statistical charts, etc.,—in transparent overlay form:

Instead of trying to apply paints to non-absorbent surfaces, draw separate details—in pencil or ink—on translucent paper, and reproduce each sheet on Ozachrome film of the desired color (black, blue, red, yellow, sepia). The job is finished by stapling Ozachrome Transparencies in register.

SAVE PHOTOGRAPHY! Beautiful Ozalid Dryphotos—with full tonal values—are produced in seconds from film positive "Masters" (made from any negative). Keep film positives of your products on file. Fill requests for "photos" as fast as they are received.

See the 10 different types of prints you can make . . . and learn the complete Ozalid story—including specifications of machines for all production requirements. Write today for free booklet No. 144.

OZALID

DIVISION OF GENERAL ANILINE AND FILM CORPORATION
JOHNSON CITY, NEW YORK

Ozalid in Canada—Hughes Owens Co., Ltd., Montreal

used is the weighted average of that granted those companies plus 0.0025 percent.

OPA pointed out that the cost of materials made up about 60 percent of the lighting fixture cost in 1941 and that the increases in cost of wire, steel, stampings and transformers have exceeded 10 percent since that date.

•

Air-Conditioning Equipment Moving Toward Mass Output

Industry is moving toward mass production of air-conditioning equipment with a speed comparable to that which brought mechanical refrigeration into almost every home in only a few years, the Refrigeration Equipment Manufacturers Association revealed recently.

Models are ready and the industry has two to three times its pre-war productive capacity. All that is lacking for immediate output in volume is sufficient materials. As is the case with other segments of the electrical industry, copper and steel are the most pressing shortages, the association spokesman continued.

Mass production and distribution of air-conditioning equipment will be accomplished with far less difficulty, than was the case with mechanical refrigeration, it was stated. This is expected to be true even though most of the problems of humidity control, air circulation, purification and heating, as well as cooling, are not present in refrigeration for food preservation.

Appearance of many new models indicate what is in store in the "space conditioner" field alone. Units range from room coolers and conditioners in cabinet and window types to models which may be wheeled from room to room and models which combine cooling and heating for year round comfort.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

W. N. Matthews Corp., St. Louis, has appointed the E. H. Gilliam Co., which has been agent for the corporation in Virginia and North Carolina, agent in South Carolina. H. C. Biglin Co., for many years agent in Georgia, has been appointed agent in Alabama.

Babcock & Wilcox has appointed Joseph T. Ryerson & Son, Inc., steel distributor with warehouses in eleven cities, as distributors.

Curtis Lighting, Inc. has named Walton T. Woods, Jr., representative in Atlanta, Ga. The Atlanta territory covers Georgia, South Carolina and parts of Florida and Alabama.

FIELD REPORTS ON BUSINESS

Numerous orders are being received for diversified electrical apparatus. Line insulators are prominent in the new orders, but acute shortages in insulating materials are causing some concern. Lighting equipment is in high demand.

PACIFIC COAST

By sheer volume, housing construction, though low in electrical content, is a major source of electrical business along the coast, with the additional merit of being very likely to be approved for allocation. Also it brings sizable jobs into the smaller cities. To meet the comparatively limited number of items required for such work, wholesalers' stocks of wire and conduit are good and rapidly improving, but conduit fittings and wiring device items are still low and spotty.

Electrical appliance shows just concluded in Los Angeles and San Francisco as a part of their marketing weeks, exceeded expectations for attendance, but the orders booked were largely reaffirmations of previous commitments and the displays were previews of merchandise which, with continued industrial truce, may be delivered in good though still inadequate quantities by the holidays.

Las Vegas is an outstanding western instance of reconversion from a war-time plant to a group of new peace-time industries, and machinery from its No. 2 basic aluminum plant is also aiding other locations. For example two of its 7,000-kw. rectifiers were removed and reshipped to the Pacific Salt plants in Portland and Tacoma, for chemical service in manufacturing chlorine for paper.

NEW ENGLAND

A lag in interest in heavy industrial equipment here is offset in part by numerous orders of diversified apparatus that are constantly coming in. Eighteen orders for electrically driven hay-drying blower equipment have been placed in recent weeks in Essex County, Massachusetts, following a demonstration of a 15-hp. installation at the Blackadar Farm, Haverhill, Mass. About $55,000 worth of electrical switching gear and control has been ordered from one representative for a New England hydroelectric line project and deliveries are beginning on some items. More than 150,000 line insulators have been ordered by utilities in this area but acute shortages in insulating materials are causing some concern, particularly among radio and communication equipment manufacturers. New England manufacturers recently placed bids for 300 electric space heaters and more than 50 autotransformers for CAA.

Connecticut Power Co. is installing new street lights along the Boston Post Road between the Stamford, Conn., line and St. Lukes Hill.

Remodeling and changes in restaurants and theatres in this area are calling for lighting equipment. Waldorf System plans to equip a restaurant in the Springfield (Mass.) business district at a cost of $35,000 and the M & P theatre chain will spend $4,000 for changes in a Boston theatre marquee lighting and sign display. Fenway Park, Boston Red Sox headquarters, plans to install additional communication services in its press box quarters at a cost of $20,000. An allocation of $15,000 for improvements at the Bradley Field airport, Windsor Locks, Conn., includes $10,000 for radio equipment and landing control apparatus.

CHICAGO

Reduced consumption of electricity by industrial customers was a major cause of the 10.5 percent drop in kilowatt-hour sales by Commonwealth Edison Co. during the first six months of 1946. The industrial decline was greater than the percentage indicates, since it was partly offset by increased residential and commercial sales.

The greatly increased supply of silver has permitted expanded activities by many electrical firms in this area. Fansteel Metallurgical Corp., for example, which produces electrical contacts from silver for circuits, relays and switches, has added a second production shift, and will add a third fabricating shift when workers are available. The dearth of silver since the first of the year held up production of many items. Manufacturers of busbars for power transmission report a marked improvement in the silver situation.

Both employment and payrolls in the Illinois electrical machinery manufacturing industry during May dropped appreciably from the April level, with payrolls 23.3 percent lower and employment 0.9 percent lower. The trend since the beginning of the year in number of employees had risen steadily from an index of 102.0 in January to 110.8 in April, then leveled off to 110.4 for May.

Building activity in the Chicago metropolitan area for the first half of the year exceeded by $7,500,000 the total of $134,000,000 for the entire year 1945. The picture, statewide, was a 43.3 percent rise in permit valuation for June, compared with May, due chiefly to a sharp rise in nonresidential construction.

NEW YORK

Equipment and appliances are continuing to arrive in increasing numbers. This past week was the best in volume received since V-J day. New York distributors state that the upturn began early in June and has grown progressively better each week.

Prices on well-known makes of appliances are remaining steady, but the new or little known brands are being reduced. This week there was a 15 percent slash in unknown table model radio sets. Irons and traffic appliances carrying store brand names have been cut as much as 20 percent in several instances.

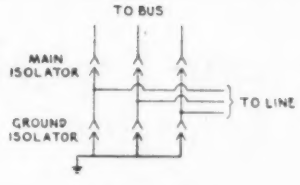
Although refrigerators and home freezers are arriving in better volume, the demand is almost unsatisfiable. Distributors estimate that at least one-third need immediate replacement and that the pipe line will remain empty until late next year.

Equipment for ventilating the Brooklyn-Battery tunnel has been ordered. The 27 supply fans and the 26 exhaust fans will be supplied by B. F. Sturtevant and will move 25,000 tons of air per hour. These will be coupled to Westinghouse motors.

Whether DISCONNECTING OR GROUNDING

YOU CAN DO IT Better WITH AN ISOLATOR* . .

*The Isolator is a high voltage disconnect enclosed in insulation, operation of which is accomplished by a telescoping action of contacts and insulating bushings.



AMONG the many advantages of the Isolator over the open blade disconnect is the ease and simplicity with which circuit grounding can be accomplished. Figures 1, 2 and 3 illustrate a PST, 600 ampere, 15 kv. isolator with positive and quick grounding arrangement. A small extension to the Isolator frame, three ground contacts and a carriage with linkage are all the additional equipment necessary to provide this feature on a standard Isolator. Figure 1 shows the three-position control handle with the Isolator closed to the bus. Figure 2 is a front view with both the bus and ground connections open. Control handle is definitely stopped in the middle position and must be released by a separate operation before throwing to the ground. Figure 3 shows the circuit solidly grounded. This control arrangement provides a positive interlock between the bus and ground position.

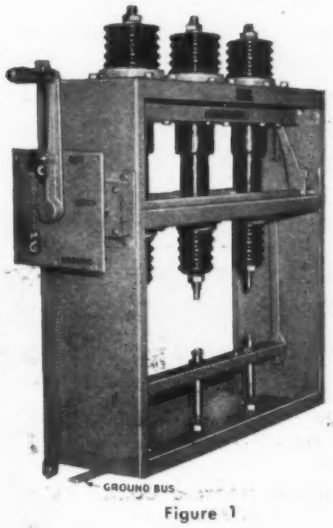


Figure 1

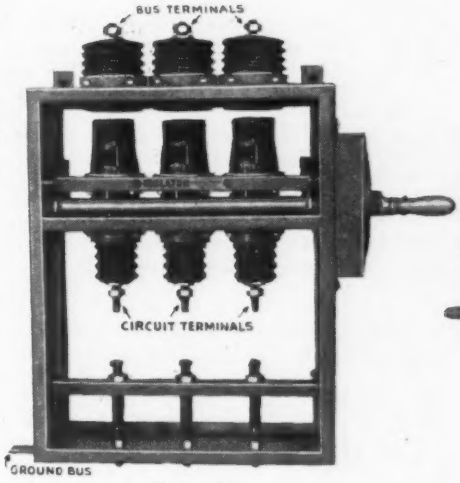


Figure 2

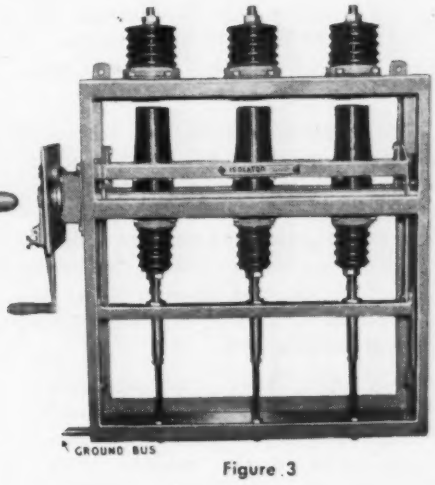


Figure 3

Other advantages of the Isolator are the following:

1. **SAVES SPACE** in cubicles and bus structures.
2. **SAVES STEEL.** When Isolators are used in cubicles, the cubicle structure can be made considerably smaller.
3. **SAVES LABOR.** Because Isolators are factory assembled into rigid units, a minimum of labor is required to install.
4. **SAVES INSULATORS.** Top fittings can be supplied on Isolators to carry bus, thus eliminating the necessity of bus supports.
5. **SAVES CONNECTIONS.** When the Isolator is so supplied, it is not necessary to have jumper connections from bus to the disconnect.
6. **SAVES INSULATING BARRIERS.** Since all live parts are enclosed in insulation, the Isolator provides its own barriers.
7. **SAVES ACCIDENTS.** It is not possible to come in contact with live parts of the Isolator in either the open or closed position.

•

Isolators have been supplied to hundreds of privately-owned and publicly-owned power bodies in the United States, and have been exported to many parts of the world. If you have high voltage disconnect problems, it would pay you to look into the many advantages that can be obtained from using Isolators.

•

The Isolator, when combined with a pothead body, makes a disconnecting pothead designated as a Cable Isolator. It is a highly efficient device for disconnecting and terminating lead-covered power cables.

•

WRITE FOR BULLETIN 135
IT TELLS THE WHOLE STORY

THREE

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK ILLINOIS

Where and How to Use *Crapo* Steel Conductor

Ask for This Guide to Low-Cost Rural Lines!

If future plans call for the extension of rural service, be sure to ask for a copy of this Manual! A study of its contents will show where and how *Crapo* Steel Conductors can be used to profitable advantage in rural distribution systems.

This illustrated book contains pertinent data on the electrical characteristics and electrical performance of these unique conductors. It shows how construction costs can be reduced by the use of long spans, gives initial and final sag and tension data, describes construction practices, cites typical installations.

***Crapo* Steel Conductors are especially applicable to rural taps and branches where construction and maintenance costs are important considerations. The experience of a number of leading utilities over a period of years shows conclusively that *Crapo* Steel Conductors are giving dependable, economical and efficient service on thousands of miles of line in rural areas.**

Crapo Steel Conductors are distributed by Graybar Electric Company, Inc. Ask a Graybar representative for a copy of the *Crapo* Steel Conductor Manual or write direct for Manual No. 110-C.

Indiana Steel & Wire Company
Muncie, Indiana

***Crapo* Steel Conductors**

Acme Wire Merchandising Insulating Varnishes

After many years of making varnishes and filling, impregnating and molding compounds for their own use, Acme Wire Co., New Haven, Conn., has begun to merchandise these items. Among the insulating varnishes developed by the company are five of the clear thermosetting types, two of the black thermosetting type, and one of the clear oxidizing type. The filling, molding, impregnating and coating compounds are thermosetting organic resin compounds which are 100 percent solids. H. B. Bassett, Acme vice-president, reports. The new line of varnishes and compounds will be sold through the company's regular agents who also handle magnet wire and insulating papers and cloths.

•

Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies that have recently issued earnings reports are the following:

ALLIS-CHALMERS MANFACTURING—Net loss for second quarter, $6,675,476 and in the six months ended June 30, $8,926,432. The net loss was attributed for the most part to a decline in billings caused by the prolonged strike and also to increases in material and labor costs which were not recoverable under established ceiling prices. The operating loss does not reflect refunds or credits for the prior years' federal income taxes under the Internal Revenue Code, or possible credits against taxes that might otherwise be payable on profits of the last six months of 1946. Billings in the second quarter amounted to $23,254,087 and bookings totaled $35,057,760. This compares with the 1946 first quarter billings of $28,713,029 and bookings of $37,908,639. Unfilled orders on June 30, 1946, amounted to $65,171,780, compared with $53,368,107 on March 31, 1946.

LA CONSOLIDADA, S. A.—A leading manufacturer of steel products and copper wire and cable in Mexico reports for the quarter ended March 31, 1946, net income of $347,716, compared with net income of $118,437 for the similar 1945 quarter. For the full year 1945 the company reported net income of $319,309. New production records were made in each of the first three months of this year and sales for the first quarter amounted to $2,610,216, against $1,550,266 for the similar quarter of 1945. All figures have been converted from Mexican pesos to United States dollars at the exchange rate of 20.60 cents a peso.

ROME CABLE—June quarter, net profit, $233,488, equal to $1.22 a share, compared with $122,102, or 64 cents a share last year. The report stated that no allowance was made for dividends on the new cumulative convertible preferred shares in the 1946 quarter because the dividend accumulation did not begin until July 11.

WORTHINGTON PUMP & MACHINERY—Including domestic subsidiaries, six months, net profit $256,680, equal to $1.81 a share on 141,548 shares of combined preferred stocks, contrasted with net profit of $1,466,995, or $10.36 a share last year.

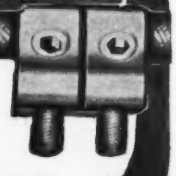
DOSSERT CONNECTORS

A heavy duty variable bolt-type lug. Adaptable for all types of service.
For a complete listing of power connectors send for Catalog 45.
DOSSERT MFG. CORP.
249-255 Huron St., Brooklyn, N. Y.

Private Capital Available

Group will invest in, or purchase outright, business propositions of merit. Size no object. Write 8EW-Box 226, Church Street Station, New York 8, N. Y.

Conductor Fittings



Cable Taps, Lugs Tees, Service Connectors, Grounding Clamps, Straight and Parallel Connectors, Elbows, etc., etc.

PENN-UNION ELECTRIC CORP.
ERIE, PA.

PENN-UNION

BUY
all the U. S. Saving Bonds you can
and
KEEP
all the U. S. Saving Bonds you buy

SENSITIVE LOW-POWER RELAYS in a newly improved design

FOR USE ON AC AND DC

Engineering superiority in every mechanical and electrical detail makes Struthers-Dunn Type 112 Relays far and away "tops" for sensitivity and durability for low-power operation on the order of a few milliwatts • A "fool-proof" micrometer adjustment assures exceptionally reliable setting of the contact spring • All parts are of low-inertia, quick-acting design • Contacts are easy to adjust and stay "put" once adjusted • Coils are well insulated and vacuum impregnated • These new relays are built throughout for easier installation, higher sensitivity, longer life • Available in single-pole double-throw and double-pole double-throw contact combinations.

Write for Data Bulletin 112.

S-D

5,327 RELAY TYPES

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STRUTHERS-DUNN, Inc., 1321 Arch St., Phila. 7, Pa.

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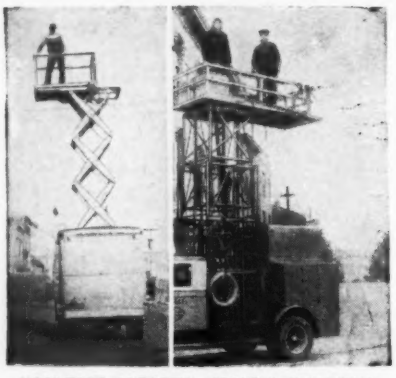
DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL
NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

PIONEER MFRS. OF
Truck Winch & Crane Equipment
FOR PUBLIC UTILITIES
1918-1946—OUR 28TH YEAR



"SILENT HOIST" TRUCK TOWERS

PANTOGRAPH TOWERS: The Pantograph Tower is power operated, entirely mechanical, utilizing no cables, no sheaves, no hydraulic devices, etc., which are subject to wear. It provides for maximum safety and minimum maintenance.

SECTIONAL TOWERS: Power Operated Telescopic-Section Tower. Electrically welded steel, 2 or 3 sections, plain or rotating platform.

A complete line of Power Winches, Pole Derricks, and Swing Boom Cranes are available. Write for Catalog No. 60

TYPICAL USERS: AT&T; N. Y. Tel. Co.; T. V. A.; Virginia P. S. Co.; Consolidated Edison Co.; etc.

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Pittsburgh, Pa.

SALES OPPORTUNITIES

IOWA—Town Council, Bellevue, will receive bids until September 4, for furnishing and installing one diesel engine-generating unit, 375 to 450-kw. capacity, in municipal power plant, including exciter and complete auxiliary equipment. Also for alternate bid for similar type generating unit of 550 to 650-kw. rating. Stanley Engineering Co., Muscatine, is consulting engineer.

ILLINOIS—Pillsbury Mills, Inc., Springfield, flour, feed, etc., plans expansion in local mill, comprising new multi-story building and several smaller structures, with machinery and electrical equipment for large increased capacity. Cost about $950,000. Project has been approved by CPA and work will begin at early date. Main offices in Metropolitan Bldg., Minneapolis, Minn.

CALIFORNIA—Department of Water and Power, 207 South Broadway, Los Angeles, is completing plans for new two-story power substation at 11170 Nebraska Ave., West Los Angeles, 57 by 126 ft., for distribution service in that area. Materials will be purchased by city and construction carried out by force account. Cost estimated about $355,000. Project has been approved by CPA. Design and Construction Division, 311 South Spring St., in charge.

MONTANA—Bureau of Reclamation, Denver, Colo., will receive bids until September 3 for one 69,000-volt, 600-amp., three-pole, single throw, manually gang operated, outdoor-type disconnecting switch, with manually gang operated grounding blades, for Savage pumping station 69-kv. transmission line, Fort Peck project, Montana. Equipment will be installed by government (Specification 1458).

OHIO—Perfection Stove Co., 7609 Platt St., Cleveland, plans new addition to local Ivanhoe plant, 1135 Ivanhoe Rd., one-story, about 435,000-sq. ft. floor space with machinery and electrical equipment. Cost reported close to $1,900,000. Project approved by CPA; erection scheduled to begin soon. Company also is planning for complete mechanism of works, with installation of conveyors and other handling equipment, reported to cost over $1,000,000.

MINNESOTA—City Council, Alexandria, will receive bids until September 9, for turbine-generator unit for installation in municipal power plant, with complete auxiliary equipment, forming part of expansion program to be carried out at station. Pfeifer & Schultz, Wesley Temple Bldg., Minneapolis, are consulting engineers.

LOUISIANA—War Department, Washington, D. C., has authorized plans for new general medical and surgical hospital at Shreveport, for Veterans' Administration, comprising extensive group of one and multi-story buildings for institutional service. Installation will include power substation, boiler house, underground and overhead lines for distribution and exterior lighting, electric elevators, air-conditioning system, refrigerating plant, and other electrical and mechanical facilities. Cost estimated about $6,586,000. Bids will be asked in fall. Neild & Sondal, City Bank Bldg., Shreveport, are architects. Project will be supervised by District Engineer Office, U. S. Post Office and Courthouse Bldg., Vicksburg, Miss.

WISCONSIN—Lakeside Aluminum Co., Menomonie, plans new power plant at local works, 32 by 43 ft., with 75-ft stack. Work will be placed under way at early date. Klinger, Hubbard & Gohn, 218 South Barstow St., Eau Claire, are engineers.

COLORADO—Bureau of Reclamation, Denver, will receive bids until September 24 for three 21,000-hp., 400-rpm., vertical-shaft hydraulic turbines with pressure regulators; three governors with pumping equipment for regulating speed of turbines noted; and for three 16,667-kva., 400-rpm, 6,900-volt, three-phase, 60-cycle, vertical shaft a.c. generators, for Estes hydroelectric power plant. Also for one 11,300-hp., 327-rpm., vertical-shaft, hydraulic turbine with pressure regulator; one governor with pumping equipment for regulating speed of turbine; and one 9,000-kva., 327-rpm., 6,900-volt, three-phase, 60-cycle, vertical-shaft, a.c. generator, for St. Mary's Lake hydroelectric power plant, Colorado-Big Thompson project. Equipment will be installed by government (Specification 1466).

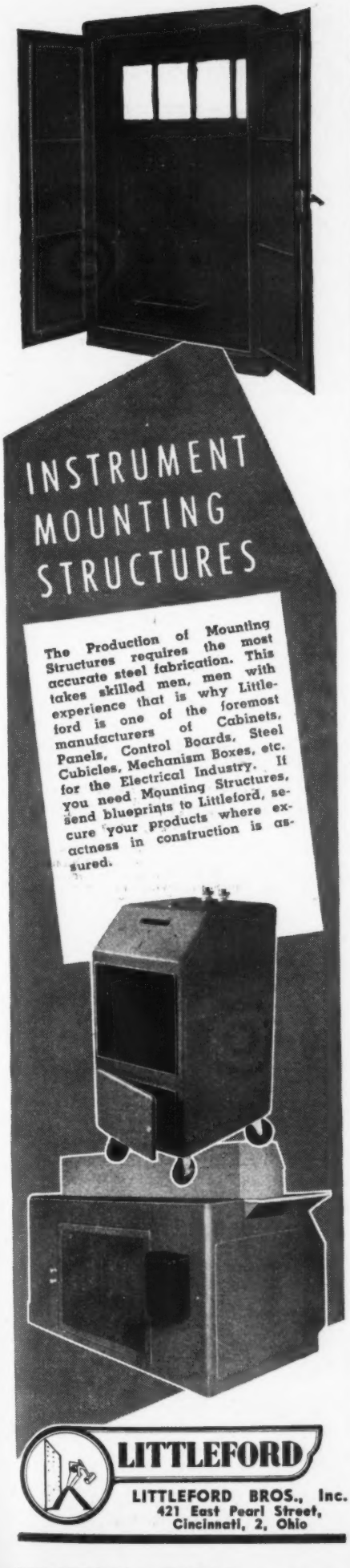
CALIFORNIA—Converse Rubber Co., 392 Pearl St., Malden, Mass., plans new branch plant at San Bernardino. It will comprise a main one-story processing and production building, about 250,000-sq. ft. floor space, with machinery and electrical equipment for large output. A power substation and boiler house will be built. Cost about $1,000,000. Anderson Nichols Associates, 53 State St., Boston, Mass., and 210 West 7th St., Los Angeles, are architects and engineers.

CONNECTICUT—United Illuminating Co., New Haven, plans early erection of superstructure for new addition to English generating station, Grand Ave., 75 by 200 ft., and 150 ft. high, to be equipped for increased capacity. Permit has been secured for foundations, for which work will proceed at once. Cost reported in excess of $1,000,000. Westcott & Mapes, 109 Church St., New Haven, are consulting engineers.

WASHINGTON—Bureau of Reclamation, Denver, Colo., will receive bids until September 9 for seven motor-driven, vertical-shaft pumping units, complete for installation in six relift pumping plants, Pasco lateral system, Columbia Basin project. Equipment will be installed by government (Specification 1461).

NEBRASKA—Consumers Public Power District, Columbus, plans extensions in transmission and distribution lines in Butler and Saunders counties, totaling 104 miles; also for similar line extensions in parts of Platte and York counties. Application has been made to State Railway Commission and work will begin when authority is granted.

ILLINOIS—Commonwealth Edison Co., Chicago, will award contract soon for addition to Roseland substation, 10847 South Michigan Ave., consisting of a one-story switchhouse, 46 by 96 ft., and transformer court, 55 by 125 ft. Cost reported close to $300,000, with equipment. Holabird & Root, 333 North Michigan Ave., Chicago, are architects.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STRUCTURES
The Production of Mounting Structures requires the most accurate steel fabrication. This takes skilled men, men with experience that is why Littleford is one of the foremost manufacturers of Cabinets, Panels, Control Boards, Steel Cubicles, Mechanism Boxes, etc. for the Electrical Industry. If you need Mounting Structures, send blueprints to Littleford, secure your products where exactness in construction is assured.
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Cincinnati, 2, Ohio

Recent Rate Changes

DANBURY & BETHEL GAS & ELECTRIC CO. has been authorized by the Connecticut Public Utilities Commission to establish revised rates effective August 1, under which electric revenues will be cut about $55,000 per year for domestic service, $8,400 for commercial service, $2,500 for industrial service, $1,100 for street lighting plus an equivalent reduction of $4,000 in the last-named category due to replacing 60-cp. by 100-cp. lamps. Gas rates will be increased. The revised commercial rates will terminate November 1, 1946, unless the commission approves their continuance, as the board is not convinced that commercial customers are not carrying more than their share of the proper costs of supplying electric service.

NEW ORLEANS PUBLIC SERVICE, INC., has agreed to make a reduction of $1,000,000 annually in its electric rates within 60 days. The earnings on the investment of the utility are limited under its franchise, and city officials will determine how the rates will be cut.

LOUISIANA POWER & LIGHT CO. has been ordered by the Louisiana Public Service Commission to reduce its rates to make possible annual savings to consumers of approximately $700,000 annually. The reduction under the new schedule is about 10 percent on domestic and commercial rates and somewhat smaller on industrial rates.

ILLINOIS POWER CO. has been ordered by the Illinois Commerce Commission to reduce its residential, commercial, and rural rates to reflect an annual saving of $500,000 to customers. When the new rates become effective, September 1, the company's 144,954 residential customers will save $311,419 annually, its 22,153 commercial customers $71,979, and its 16,000 rural customers $52,330.

SOUTHWESTERN GAS & ELECTRIC CO. has been ordered by the Arkansas Public Service Commission to reduce its rates as of July 24 to effect annual savings of $205,000 for its 18,000 Arkansas customers. The reduction is about 13 percent of the company's annual billing in the state.

KANSAS CITY POWER & LIGHT CO. has filed with the Missouri Public Service Commission a voluntary rate reduction averaging 12½ percent for residential users or a total of $1,800,000 annually. The reduction will be effective September 1.

COLORADO PUBLIC UTILITIES COMMISSION has made effective electric rate reductions in Colorado Springs (municipally owned plant and distribution system) and in the Sterling area, served by the Public Service Co. of Colorado. The Colorado Springs revision will reduce consumers' bills approximately $62,000 annually. At Sterling, which recently rejected municipal ownership, rural consumers will benefit to the extent of approximately $5,000 a year.

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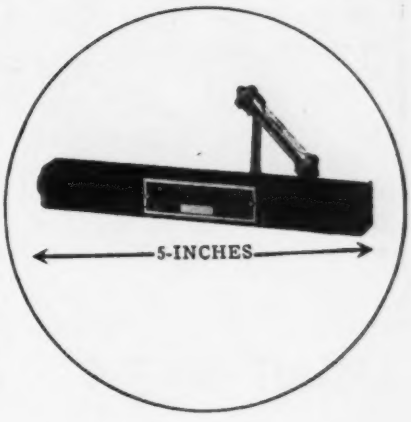
WAA Sells Rubber Plant

War Assets Administration has announced the sale of a synthetic rubber plant in Louisville, Ky., to B. F. Goodrich Co., the war-time operator, for $4,250,000. The plant, which cost the government $10,719,097, has a rated capacity of 60,000 long tons of synthetic rubber a year.



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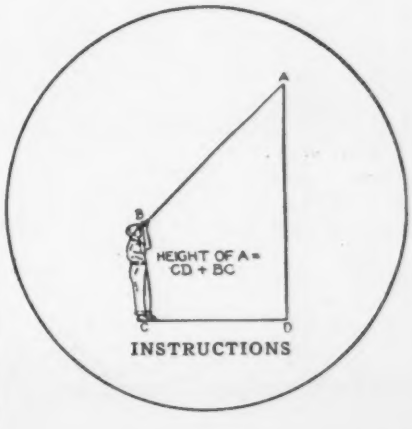

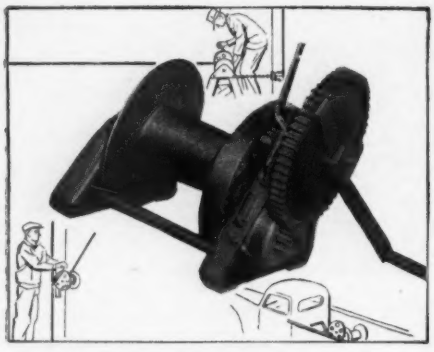

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BOOK REVIEWS

Steam Power Plant Auxiliaries and Accessories. By Terrell Croft. Published by McGraw-Hill Book Co., Inc., New York. 583 pages, illustrated. Price $5.

Revision of the 1922 book reflects modern practice in text book pattern. Many an engineer in cognate fields, particularly one who applies electric drive and controls for station auxiliaries will welcome knowing about the types of pumps, boiler feeds, heat adders and extractors, condensers, cooling towers and how their duty can be computed in terms of dimensions and power requirements. Other accessories discussed are steam piping, separators, traps and spray ponds.

Inductance Calculations. By F. W. Grover. Published by D. Van Nostrand Co., New York. 286 pages, illustrated. Price $5.75

Profundity of formulas for inductance is probably more a deterrent to straightforward computations than scarcity. Few, however, indicate the limits of their applicability and as a result many assertions about inductance are based on good empirical guesses. This text classifies the inductors and the multiplicity of formulas and correlates them. There are numerous interspersed tabulations that will give answers without recourse to the formulas. Before taking up the inductive characteristics of straight filaments (Part I) and coils (Part II) in all their ramifications there are terse chapters on the fundamentals of induction and geometric mean distances.

Soul of Lodestone. By Alfred Still. Published by Murray Hill Books, Inc., New York. 293 pages. Price $2.50.

Written in the same vein of impartial recording of the historical notations as "Soul of Amber," this companion book ought to satisfy the large number of electrical engineers who one day weary of the rigors of the art and like to delve into its fragmentary beginnings. The author tells whence he collected his information and something about the early philosophizers. One closes the book with the definite feeling that cogitation and musing about obscure phenomena during long centuries is what made the electrical engineering of today and that similar inquisitiveness and meditation are fully as much called for now. The recital is most interesting reading aside from the stimulus it presents.

Switchboards and Panelboards. 150 pages, price $3.
Industrial Electrical Heating. 192 pages, price $3.
Industrial Electric Control. 374 pages, price, $3.

These are three more in E. S. Lincoln's "Modern Electrical Series" published by Essential Books, New York 16, and continue the program of stating the simple principles, listing the desirable magnitudes and characteristics, portraying the prevailing forms in which equipment is available, how to select and apply them in conformity with duty requirements and the imposed codes.

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Opens Rochester Office

Opening of a new office in Rochester, N. Y., by the Minneapolis-Honeywell Regulator Co., has been announced. Located in the Exchange Building, 16 State St., the new office will be under the supervision of Stanley H. Perkins.

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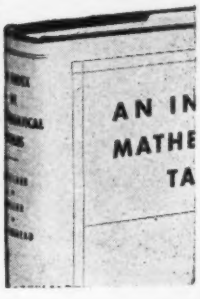

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